APPLICATION FOR RENEWAL OF PERMIT TO OPERATE A CLASS I MUNICIPAL SOLID WASTE FACILITY AT THE MILLARD COUNTY LANDFILL

Prepared for:

Millard County
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March 2006

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EXECUTIVE SUMMARY

The Millard County Landfill is located approximately six and three-tenths (6.3) miles east/southeast of Delta in Millard County and serves the residents and businesses of the County. The landfill is an existing Class I facility which must be in regulatory compliance with the Utah Solid Waste Permitting and Management Regulations (Utah Administrative Code R315-301-320 Revised October 15, 2003). Based on the information presented in this renewal application, along with the original application, Millard County requests that a Permit to Operate a Class I Landfill be granted by the Utah Department of Environmental Quality for the continued operation of the Millard county landfill.

Please refer to Millard County's original application for a Permit to Operate a Class I municipal solid waste disposal facility at the Millard County Landfill, which consists of a Plan of Operation, Closure and Post-Closure Plans, a Geohydrological Assessment, and Engineering Report. The application was prepared in accordance with R315-310-4 of the Utah Administrative Code, and the outline contained in the Application for a Permit to Operate a Class I or Class V Landfill provided by the Utah Department of Environmental Quality.

In November of 1994, an *Application for a Waiver from Ground Water Monitoring and Liner Requirements at the Millard Landfill* was submitted to UDEQ (Utah Department of Environmental Quality) for consideration. The waiver application is considered an integral part of the original application, and provides a large portion of the information contained in geohydrological assessment as required by the Utah Administrative Code (UAC) R315-310-4(2)(b). The waiver is included with the original application as Appendix E. Related correspondence for UDEQ regarding the content of the waiver application and the issuance of such waiver is also included in Appendix E.

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Appendix B: Land Use Zoning Documents ..... attached

Appendix C: Landfill Property Deed ..... attached

Appendix D: Record keeping and Inspection Forms ..... attached

Appendix E: Application for Waiver from Ground Water Monitoring and Liner Requirements at the Millard County Landfill, Submitted to UDEQ November 1994, related correspondence and Response to Request for Additional Information from UDEQ. ..... attached

Appendix F: Loading Rate Calculations ..... attached

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PART I - GENERAL DATA

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF SOLID AND HAZARDOUS WASTE

APPLICATION FOR A PERMIT RENEWAL TO OPERATE A CLASS I OR CLASS V LANDFILL

The application shall submit, in duplicate and original permit renewal application, a general report and a technical report to:

Dennis R. Downs, Director
Division of Solid and Hazardous Waste
Utah Department of Environmental Quality
P.O. Box 144880
Salt lake City, UT 84114-4880

PART I - GENERAL DATA

1. **Name of Facility:** *Millard County Landfill*

2. **Site Location:** *N ½, SE 1/4, Sec 24, T17S, R6W.*

3. **Facility Owner:** *Millard County*

4. **Facility Owner:** *Millard County*

5. **Contact Person:** *Sheryl Dekker*
Landfill Operations Manager

Address: *71 South 200 West*
P.O. Box 854
Delta, Utah 84624

Telephone: *(435) 864-1400*

Fax: *(435) 864-1404*

e-mail: sdekker@co.millard.ut.us

5. **Type of Facility:**

- ● Class I Landfill
- ○ Class V Landfill
- ○ Initial Application
- ● Permit Renewal
  Original Permit Number **9431**

6. **Property Ownership:**

- ● Presently owned by applicant
- ○ To be purchased by applicant
- ○ To be leased by applicant

7. Certification of Submitted Information:

Official: Kathy Y. Walker
Title: Chairman, Millard County Commission

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: Kathy Y. Walker Date: March 10, 2006

SUBSCRIBED AND SWORN to before me this 10TH day of MARCH, 2006.

Sheryl L Dekker

My Commission Expires on the 2ND day of AUGUST, 2007.

SHERYL L. DEKKER
Notary Public
State of Utah
My Commission Expires 08-02-2007
71 South 200 West, Delta, Utah 84624

PART II - GENERAL REPORT

1. INTRODUCTION

The Millard County Landfill is located approximately six and three/tenths (6.3) miles east-southeast of Delta City in Millard County, Utah, as illustrated in Drawing A-1, Appendix I (Title Sheet and Site Vicinity Map). The site is an existing landfill which accepts approximately 20 to 25 tons of waste per day, and is therefore a Class I facility as defined by the Utah Solid Waste Permitting and Management Rules (UAC R513-301-2). The site is currently operating under Utah Solid and Hazardous Waste Control Board Solid Waste Permit # 9431 which was issued April 1, 2001. This permit expires at midnight 31 March 2006. A copy of the permit is attached in Appendix "A" of Millard County's application.

1.1 Types of Waste Received

The Millard County Landfill accepts the following waste types for disposal or recycling:

- household/private;
- commercial;
- industrial;
- construction/demolition;
- dead animals;
- white goods;
- automobiles;
- tires;
- medical waste;
- asbestos;
- yard wastes; and,
- household hazardous wastes.

The procedures and disposal methods of these various waste types are described in Section 2.3 of this report.

1.2 County Solid Waste Management Plan

The landfill is an integral element of the Millard County Solid Waste Management Plan. The facility accepts all of the solid waste generated in the eastern and central service areas as defined in the Millard County Solid Waste Management Plan (Stansbury Design, 1993) and is still in effect.

1.3 Property Description and Ownership

As described by the Public Land Survey system and illustrated on Drawing B-1 (Appendix I), the Millard County Landfill occupies the N1/2, SE1/4, Sec. 24, T.17S., R6W., Salt lake Base and

Meridian (SLB&M). The latitude and longitude of the entrance to the facility, at the southwest corner of the northeast quarter of the southeast quarter of Section 24, are estimated as 39°19'14" and 112°28'17", respectively. The property is in an area which has a land use/zoning designation of RF-20 (Range and Forest). The Millard County Planning and Zoning Commission passed an ordinance on January 10, 2994, amending the allowable land use description of zone RF-20 to include solid waste disposal subject to a Conditional Use Permit. A copy of the supporting documentation is included in Appendix B. The land use zoning of the area surrounding the Millard County Landfill is illustrated on Drawing B-1 (Appendix I).

The Landfill property was deeded to Millard County by the Bureau of Land Management on August 23, 1995. The deed was recorded with the Millard County Recorder's Office September 25, 1995 (Attachment C).

2.0 PLAN OF OPERATION

Millard County is submitting the following Plan of Operation for a Class I municipal landfill at the Millard County Landfill as required by the Utah Solid Waste Permitting and Management Rules, R315-301 through R315-320 of the Utah Administrative Code (UAC) Solid Waste Rules as the Solid Waste Management Authority for Millard County, and conforms to UDEQ regulations governing solid waste sites and facilities. This Plan of Operations is submitted as part of an application for a permit to operate a Class I site, as required by UAC 315-310-4 of the UAC.

The Millard County Landfill is owned and operated by Millard County. County Offices are located at 71 South 200 West, Delta, Utah. The Plan of Operation shall be retained at the office of Millard County and shall be provided to the Solid Waste Management Authority upon request for review. The responsibility for compliance with the plan shall be that of the Operations Manager. The plan shall be available for review by employees involved in daily operations, as well as to regulatory agencies and other parties, as requested.

Prior to the implementation of operational modifications, regulatory requirements shall be assessed to ensure the compliance criteria are satisfied. Waste management practices not included in this Plan of Operation shall be submitted to UDEQ prior to implementation. These may include expansion of services or changes in disposal areas within the property boundary. Approved requests for modifications in operational standards and practices shall be incorporated into the Plan of Operation upon final approval by the Utah Department of Environmental Quality.

2.1 Hours of Operation

The Millard County Landfill is open to the public from 10:00 a.m. to 6:00 p.m. during the spring and summer months, and from 9:30am to 5:30pm during the fall and winter. The time changes take affect when daylight-saving time changes occur. The Landfill is open Monday through Saturday, 313 days per year. There will be a landfill attendant on-site at all times during the operating hours.

2.2 Schedule of Construction

The Millard County Landfill utilized excavated trenches for solid waste disposal. The facility is currently filling the seventh trench excavated since the opening of the Landfill in 1986. The first trench was located along the eastern boundary of the site. Trenches are being excavated from east to west across the property. Based on current and projected incoming waste volumes and trench sizes, a new trench is required approximately every three years. The current trench is projected to last for approximately three more years. Drawing B-2 (Appendix I) illustrates the conceptual phased construction across the landfill property.

2.3 Waste Handling Procedures

UAC R315-302-2 requires that a plan for operating a Class I landfill must provide for a description of on-site solid waste handling procedures during the active life of the facility. The Millard County Landfill accepts the following types of waste for recycling or disposal:

- household/private;
- commercial;
- industrial;
- construction/demolition;
- dead animals;
- white goods;
- automobiles;
- tires;
- medical and asbestos wastes;
- yard wastes; and,
- household hazardous wastes.

The Millard County Landfill does not accept the following types of waste:

- liquid waste;
- hazardous/PCB wastes; and,

All incoming vehicles are met by the landfill attendant. Load inspections are performed on a random basis. All incoming waste shipments are recorded on the "Daily Activity Log" form, a copy of which is contained in Appendix D. Recorded information includes vehicle type, license number, load volume estimate, date, time, and the name of the waste hauler (if possible). Waste volumes are estimated based on vehicle and load size. Landfill signs direct incoming traffic to either the active disposal area or the flesh pit location. The majority of the waste received at the landfill arrives via County or commercial collection vehicles. The general public is not allowed access to the active face. Private haulers are directed to discharge their loads in a public discharge area near the active face. Landfill personnel transport the discharged load to the active face for disposal.

The equipment used at the facility includes a Caterpillar 916 steel-wheeled compactor, a scraper, and a tracked dozer. A front-end loader is available on request from the county road department. The handling procedures used at the facility for accepted types of waste, as well as the screening procedures used to prevent prohibited materials from entering the landfill, are described in the following sections.

2.3.1 Household and Commercial Wastes

Household wastes consist of any solid waste derived from households, including garbage, trash, and sanitary wastes. Household sources may include single and multiple family residences, hotels, motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds and recreation areas used during the daytime. Commercial wastes are those wastes which are nonindustrial in nature and include solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes.

Collection and disposal services for household and commercial wastes are provided by Millard County at twelve transfer stations throughout the county, and by two commercial collectors/haulers who provide curbside residential pickup. The majority of the management of the municipal waste stream consists of the collection and disposal of household and commercial wastes. Incoming waste from county and commercial haulers is received at the active face, typically on the south end of each trench. The waste is discharged and spread in layers not exceeding two feet in thickness, and compacted using multiple passes of a steel-wheeled compactor. Private haulers are directed to an unloading area near the active face. Discharged loads are moved from the unloading area to the active face by landfill personnel and equipment. As described in this Plan of Operation, all aspects of household and commercial waste management at the Millard County Landfill are performed in accordance with appropriate federal and state regulations.

2.3.2 Industrial Wastes

The majority of industrial wastes generated in Millard County are disposed of on the generator's property. Certain industrial wastes may be disposed of at the Millard County Landfill with the prior approval of the County. The approval process is based on the waste type, quantity, and related analytical data, if required. Hazardous waste generator use the services of permitted hazardous waste facilities outside Millard County (Stansbury, 1993).

2.3.3 Construction/Demolition Wastes

Construction/demolition wastes generated within the western portion of Millard County are disposed of at the Millard County Landfill. The waste is dumped in the northern end of each disposal trench and periodically compacted and covered to prevent uncontrolled fires and rodent or vector harborage.

2.3.4 Dead Animals

Dead animals are deposited in an excavated trench referred to as a "flesh pit," which is situated in the northwest corner of the landfill property. Dead animals are covered upon arrival with a minimum of six inches of soil.

2.3.5 White Goods, Automobiles, and Tires

White goods, automobiles, and scrap metal are stockpiled on-site at the Millard County Landfill. They are periodically removed by an automobile crushing and recycling service. Tires are accepted at the face of the trench pit in maximum allotments of three from private individuals only. No tires are accepted from commercial tire dealers and no tires are stockpiled at the landfill for recycling purposes. Refrigerators will not be accepted at the Millard County Landfill without certification that the Freon has been removed. Public notice will be made to patrons of the Millard County Landfill.

2.3.6 Yard Wastes

Yard wastes may include tree and brush trimmings, grass clippings, straw and hay, and wastes from seasonal or special events. These are accepted at the facility and are deposited in the north end of each trench with construction/demolition waste.

2.3.7 Household Hazardous Wastes

Millard County currently does not have a household hazardous waste program. The majority of household hazardous wastes, such as residuals in cleaning supply containers, are managed as part of the municipal solid waste stream. Used automotive batteries are not accepted at the Millard County Landfill. They are directed to retail stores where they are accepted for an exchange value when purchasing a new battery. Waste motor oil and antifreeze are collected by local service stations. These products are periodically picked up by a licensed used oil service. Provisions for special waste disposal are not planned at this time.

2.3.8 Medical Waste

Medical and infectious wastes from medical facilities are accepted at the Millard County Landfill. Medical wastes generated at the Delta and Fillmore Community Medical Centers are delivered directly to the facility at which time the landfill operator places the waste containers at the bottom of the active face and immediately covers them with twelve inches of earth or waste material which does not contain infectious waste. The waste containers will not be compacted until they are covered.

2.3.9 Asbestos Waste

Asbestos wastes will be accepted at the Millard County Landfill if the following conditions are satisfied:

- the asbestos waste must be adequately wetted and containerized to prevent fiber release; and,

- the waste containers are labeled with the name of the waste generator, the location where the waste was generated, and tagged with a warning label that conforms to the requirements of 40 CFR Part 61.149(2).

Upon receipt of asbestos waste, the operator shall:

- verify the quantities of waste received, sign off on the waste shipment record, and send a copy of the waste shipment record to the generator within 30 days;
- require vehicles that have transported asbestos waste to be marked with warning signs as specified in 40 CFR Part 61.149;
- inspect the load to verify that the asbestos waste is properly contained in leak-proof containers and labeled properly;
- place asbestos containers at the bottom of the active face with sufficient care to avoid breaking the containers;
- cover the waste within 18 hours with a minimum of six inches of material that does not contain asbestos, or, if the waste is not properly containerized, cover immediately with six inches of material that does not contain asbestos; and,
- limit access to the asbestos disposal area until the waste has been covered with six inches of material which does not contain asbestos.

If the operator believes that the asbestos waste is in a condition that may cause significant fiber release during disposal, the operator will notify the local health department and the Executive Secretary. If the wastes are not properly containerized, and the landfill operator accepts the load, the operator shall thoroughly soak the asbestos with a water spray prior to unloading, rinse out the truck, and immediately cover the waste with six inches of non-waste material which prevents fiber release prior to compacting the waste in the landfill.

2.3.10 Liquid Waste Exclusion Program

Liquid waste management procedures are in place at the Millard County Landfill. In accordance with UAC R315-315-5(1), sewage sludge, septic tank pumpings and raw sewage are not accepted at the facility; only dry waste is allowed. Liquids which are in bulk or not in containers are not permitted for disposal in the landfill unless the waste is non-septic household waste. To qualify for acceptance, liquid-filled containers must be part of the household waste stream, small and similar in size to a container which would normally be found in household waste (five gallons or less), and must be designed to hold liquids for uses other than storage.

Operational elements of the liquid waste management program include waste stream observation and separation, and container management. The waste haulers are the first line of defense against liquid waste disposal, followed by the landfill attendants and equipment operators. All landfill staff is trained to recognize liquid-filled containers which may require segregation from the waste stream. In the event that a suspect container is observed, the spotter (hauler, landfill attendant, or equipment operator) will determine whether or not the container is empty. Only

empty, vented containers which do not contain hazardous materials are accepted for disposal. In order to dispose of suspect containers or materials, the generator must be able to provide documentation of a nonhazardous designation upon request. Accepted containers may not have more than 2 percent grease in them. Operators are instructed not to open containers without first checking with a field supervisor.

Containers which do not meet the criteria described above will be removed from the waste stream and returned to the generator. If the generator is unknown and the container is not empty, it will be stored in a designated fenced area until a hazardous waste determination can be performed by trained personnel. If the contents are determined to be nonhazardous, they will be mixed with soil and the soil and container will be disposed of on-site. If the contents are determined to be a hazardous waste, arrangements will be made by the landfill operator with a licensed transport and disposal facility to remove the container from the landfill premises. Notations will be made to the operating record that include a complete description of the actions taken and the final decision to accept or reject a suspect load. The record will also contain a complete description of the generator, including name and vehicle description. In the event of a hazardous waste determination, the Division of Solid and Hazardous Waste will be contacted.

2.3.11 Hazardous/PCB/Waste Exclusion Program

Pursuant to UAC R315-315-7, an owner or operator shall not knowingly dispose, treat, store, or handle hazardous waste or waste containing PCB. Owners/operators of all municipal solid waste landfills must implement a program for detecting and preventing the disposal of regulated hazardous waste as defined in Title 40 of the Code of Federal Regulation (40 CFR) Part 261. The waste exclusion program must also be applied to polychlorinated biphenyl (PCB) wastes as defined in 40 CFR Part 761. In addition, the Plan of Operation for a facility must include a description of procedures for excluding the receipt of hazardous waste or waste containing PCBS. Millard County will implement a series of internal procedures to satisfy this regulatory requirement. These procedures are outlined below.

Random Inspection of Incoming Loads

Incoming loads will be randomly selected to be visually inspected by landfill attendants and equipment operators who are trained and qualified to identify regulated hazardous or PCB wastes. The number of inspections will be approximately one out of every twenty loads, or approximately 1 percent of all incoming loads, which is a minimum benchmark. These loads will be inspected for free liquids and hazardous or PCB wastes. Inspections will be performed at the public discharge area by qualified personnel prior to transfer to the active face. Loads suspected of containing a high liquid content will be tested on-site by EPA Method 9095, paint filter test. Any loads failing the test will be rejected.

Load inspections and decisions which determine whether a material suspected of being hazardous, can be accepted for disposal will be made as follows:

- the waste will be unloaded in an area near, but immediately adjacent to the active portion of the trench;
- the hauler will be required to wait until the content of the load is verified;
- the waste will be carefully spread for observation using a dozer or front end loader;
- containers with contents that are not easily identifiable, such as unmarked 55-gallon drums, will be separated if a visual inspection determines that such movement will not cause the drum to open, and will be opened and inspected only by properly trained personnel; and,
- if the waste is determined to be acceptable, it may be transferred to the working face for disposal.

Tests for characteristics of hazardous wastes typically include TCLP and tests for corrosiveness, flammability, and reactivity. Wastes that are suspected of being hazardous will be handled and stored as a hazardous waste until proven otherwise. If wastes temporarily stored at the site are determined to be hazardous, and the origin of the waste is unknown, the operator will immediately contact the Delta City Fire Department and the Millard County Sheriff's Hazardous Materials personnel, which will be responsible for proper management of the wastes. If hazardous wastes are to be transported from the facility, they must be: a) stored at the landfill in accordance with the requirements of a hazardous waste generator; b) manifested; c) transported b y a licensed transporter; and d) disposed of at a permitted treatment, storage, or disposal (TSD) facility. UDEQ will be notified of the load waste characterization of any rejected loads. In addition, UDEQ will be contacted to provide guidance on the proper procedures for notifying the waste generator and instructions for proper disposal.

Records of Inspections

A record of each random inspection will be maintained in the facility operating record and made available to UDEQ upon request. The "Record of Random Inspection" form contained in Appendix D will be used to record information obtained during each inspection. Inspection records may include, but are not necessarily limited to, the following items:

- date and time waste loads were received and inspected;
- source or generator of the wastes;
- vehicle and driver identification;
- observations made by the inspector;
- description of rejected loads; and,
- rationale for rejection.

Training of Facility Personnel

Facility personnel are trained in the identification of containers and labels typically used for hazardous and PCB wastes. Training for hazardous material screening procedures address hazardous waste handling, safety precautions, and record keeping requirements. Documentation of personnel training will be included with the operating record of the facility. The training of facility personnel is an ongoing process of on-the-job, in-house, and classroom training.

Handling Procedures for Hazardous or PCB Wastes

If regulated quantities of hazardous or PCB wastes are identified on incoming independent haul vehicles, personnel at the Millard County landfill will refuse to accept the load and UDEQ will be notified. If regulated quantities of hazardous or PCB wastes are identified on incoming County or commercial haul vehicles, or at the working face of a lift, the Delta City Fire Department and the Millard County Sheriff's Office Hazardous Materials personnel will be called. The Millard County Sheriff's Office Hazardous Materials Team will act as the first responder for hazardous materials, and will implement their Hazardous Materials Response Plan. The Fire Department will manage any subsequent activities related to the waste load, including transportation, storage, and containment. Landfill personnel will participate only as directed by the first responders. Following notification, it will be the responsibility of the Millard County Sheriff's Office to ensure that the hazardous materials are handled, stored, or transported in accordance with applicable Federal and State regulation.

According to 40 CFR §262.34, wastes which are determined to be hazardous may be stored at the Millard County landfill for up to 180 days. To satisfy this section of the federal regulation, personnel at the Millard County Landfill or the Delta City Fire Department will perform the following tasks:

- waste will be place in tanks or 55-gallon containers;
- the containers will be clearly labels with the date of packaging;
- the containers will be clearly marked with the words "Hazardous Waste"; and,
- the name and telephone number of the emergency response coordinator will be clearly marked on the container.

If waste is transported off-site by a hazardous waste disposal company, a provisional or one-time U.S. Environmental Protection Agency (PA) identification number will be obtained, the waste will be packaged according to applicable Department of Transportation regulations, and the container will be properly transported and manifested to its point of destination. Proper chain of custody and a manifest document will be obtained from the hazardous materials disposal facility in order to maintain compliance with all applicable federal and state regulations.

In the event that PCB wastes are identified on-site, the Millard County Sheriff's Office or landfill personnel will store and insure disposal of the waste in accordance with 40 CFR Part 761. The following activities will occur:

- an EPA PCB identification number will be obtained;
- the PCB waste will be properly stored until transported;
- the containers will be properly marked with the words, "Caution: Contains PCBs"; and,
- the container will be manifested for shipment to a permitted disposal facility.

Notification

If suspected hazardous materials or PCB wastes are discovered during landfill operations, UDEQ will be notified within 24 hours by personnel at the Millard County Landfill. A record will be submitted to UDEQ, which identifies the date and time of discovery, type of material (if possible without analytical testing), probable hauler, quantity, and actions proposed for the removal of the material from the area of discovery. The record of notification will be entered into the operating record maintained at the facility.

2.4 Daily and Interim Cover

The soil derived from each trench excavation is stockpiled above the previously completed trench. These stockpiles effectively form an interim cover layer which currently approaches 15 feet thick in places. As previously described, incoming waste is unloaded on the ramp at the southern end of each trench. Near the end of each operating day, the waste is then spread in thin layers, not to exceed two feet in thickness, and compacted using several passes with the Caterpillar 916 compactor. Cover material is then obtained from the soil stockpile and placed over the waste layers to a minimum thickness of six inches.

A portion of each trench remains open during the excavation of the next trench, in order to receive waste during the period of excavation. As the new trench is excavated, soil is stockpiled over the filled portion of the previous trench. When the excavation of the new trench is completed, the remaining portion of the previous trench is covered by a minimum of two feet of native soil. Following the completion of filling of a trench, a minimum of two feet of stockpiled native soil will be left over the previously filled trench. In this way, all trenches will be covered by an interim cover layer immediately following closure. The interim cover will be graded away from the active disposal trench to prevent run-on flow from entering the trench prior to closure. Berms will be constructed over the interim cover as necessary to control run-on and run-off flows.

2.5 Monitoring and Self Inspections

An *Application for a Waiver from Ground Water Monitoring and Liner Requirements at the Millard County Landfill* (Vector, 1994) was submitted to the Utah Department of Environmental Quality by Millard County. UDEQ reviewed the waiver application and issued a Request for Additional Information. The additional information was supplied and a letter was issued by UDEQ to Millard County which indicated the granting of such a waiver is probable, pending the approval of the permit application. A copy of each of these documents is included in Appendix E. Based on the technical justification and correspondence contained in the waiver application (Appendix E), the proposed landfill design does not include a leachate collection or ground water monitoring system. The landfill gas monitoring program for the facility is outlined in Section 7.5 of this application. Millard County will inspect the facility no less than quarterly during the active life to prevent operator errors, discharges which may cause or lead to the release of wastes to the environment or to a threat to human health, and to ensure that proper drainage control measures are

in place to prevent run-on from entering the active trench. Inspection will include, at a minimum, detailed observations of the trench walls, the active disposal area, perimeter fencing and drainage systems, and covered fill areas. Millard County will maintain an inspection log which includes, at a minimum, the date and time of the inspection, the printed name and handwritten signature of the inspector, observations made during the inspection, and the date and nature of any repairs or corrective actions performed as a result of the inspection. The inspection logs will be kept for a minimum of three years from the date of the inspection, and will be maintained as part of the operating record withing the Plan of Operation. As with the Plan of Operation, the inspection records will be made available to the Executive Secretary upon request.

2.6 Record keeping

Millard County will maintain and keep, at the County Offices, an operating record for the Millard County Landfill, which will include the following information.

- number of vehicles entering the landfill each day, with estimated types and volumes of waste;
- deviations from the approved plan of operation;
- training and notification procedures;
- results of required gas monitoring;
- inspection log or summary;
- incident reports; and
- this application document.

The operating record for the facility will include any information pertaining to the landfill operations, including any additional information required by the Executive Secretary. Examples of forms which will be used at the landfill are included in Appendix D.

2.7 Corrective Action Plan

Based on the information presented in the Application for a *Waiver from Ground Water Monitoring and Liner Requirements* submitted to the Utah Department of Environmental Quality (UDEQ) and included in Appendix E, it is unlikely that ground water will be impacted by the operation of the Landfill. If ground water is discovered to be affected by landfill operations at some time in the future, an appropriate corrective action plan will be developed and implemented.

2.8 Contingency Plans

UAC R315-302-2(d, f, j) requires the development of contingency plans to be implemented in the event of any emergency at the site. These plans must include an organized, coordinated, and technically and financially feasible courses of action for response to fire or explosion, releases of toxic or hazardous material, landfill gas, failure of run-off containment system, and equipment breakdown. In addition, an alternative waste handling or disposal system must be developed in case the facility becomes unable to accept waste because of an emergency. The contingency plan for each of these occurrences is described below.

Note that a general emergency operations plan as been developed for Millard County. In addition, the Millard County Sheriff maintains a hazardous materials response plan. It is anticipated that one of these plans will be invoked by County personnel if the severity of an event at the landfill facility requires the participation of an emergency response team.

2.8.1 Contingency for Fire or Explosion

On-site personnel are prepared to provide immediate fire suppression in the event of an active face or structure fire. Fire extinguishers are mounted on all site equipment and county vehicles. In the event of a fire at the active face or within the waste mass, stockpiled cover soils will be used to cover the burning or smoldering area. Water will not be applied to the active face unless absolutely necessary. In the event of an uncontrolled fire or a fire that cannot be managed by on-site personnel, the Delta City Fire Department will be contacted. The Fire Department is located in downtown Delta, approximately six and three-tenths (6.3) miles from the landfill; estimated response time is 10-15 minutes. Upon arrival at the facility, the Fire Department will assume responsibility for continuing fire abatement activities.

2.8.2 Release of Hazardous or Toxic Materials

In the case of hazardous or toxic material discharges at the Millard County Landfill, the Delta City Fire Department and the Millard County Hazardous Response Team will be notified immediately and will act as the emergency response team. Upon arrival at the Landfill, the Hazardous Materials Response Team will assume responsibility for all subsequent on-site activities related to the containment, handling, and transport off-site of the discharged material. Hazardous material spills will not be handled by Landfill employees. The operations manager will serve as the Landfill staff liaison with the Emergency Management Response Team, and will ensure the safe evacuation of employees. Advanced planning of emergency exit routes is the responsibility of the Landfill Operations Manager. All employees are regularly apprised of established primary and secondary exit routes.

2.8.3 Landfill Gas

If landfill gas is discovered at the facility at levels above 25% of the lower explosive limit (LEL), operations will immediately be halted and all necessary steps will be taken to insure the protection of human health and the environment. In addition, the Executive Secretary will be notified. Within seven days of the detection of gas levels which exceed the LEL, the detected methane levels and a description of the steps taken to protect human health will be entered into to the operating record of the site. Within 60 days of detection, Millard County will develop and implement a remediation plan for the gas release, place a copy of the plan in the operating record, and notify the Executive Secretary that the plan as been implemented. Landfill gas monitoring will be performed on a quarterly basis as described in Section 7.5 of this application.

2.8.4 Failure of Run-off Containment System

Due to the method of disposal utilized at the Millard County landfill, a breach in the integrity of the run-off containment system will not result in the release of contact waters to the

areas outside the landfill property. All incoming waste is deposited on a ramp at the southern end of the trench prior to compaction. The ramp slopes to the bottom of the trench. Any breach in the integrity of the run-off containment system at the Landfill will be repaired immediately after run-off flows have receded to an acceptable level.

2.8.5 Equipment Breakdown

Routine equipment maintenance is performed on-site by landfill staff. Equipment repairs are performed on-site by mobile repair units, or the equipment is transported off-site to the repair vendor or to the County Road Shop. Backup equipment can be provided by other Millard County departments within a matter of several hours if necessary. Additionally, auxiliary equipment may be leased from a private contractor as required.

2.8.6 Alternative Waste Handling

In the unlikely event of an emergency which requires the short term closure of the landfill, several options are available. Waste collection may be temporarily discontinued, providing the duration of the crisis is short enough. During such an event, waste which has already been collected will be stockpiled off-site on county owned land. Additional 4-yard roll-off bins may be acquired to accept additional waste volumes at the County's transfer stations. In the event that the landfill is unable to accept waste for an extended period of time, waste may be long-hauled to the Juab County Landfill.

2.9 Installed Equipment Maintenance

Based on the issuance of a waiver from ground water monitoring and liner requirements, there will not be any leachate collection or treatment equipment installed at the site. Culverts installed beneath site roadways will be inspected during the quarterly site inspection. Clogged culverts will be cleared as soon as possible. Any additional equipment which may be installed at the facility will be inspected in the quarterly monitoring program.

2.10 Vector Control

Appropriate vector control procedures are used at the Millard County Landfill for the protection of public health and safety. Compaction and grading of waste at the active face prevent vector harborage in, and access into the waste mass. The subsequent application of six inches of cover soil on a daily basis also deters, reduces, or eliminates entry spaces, food sources, and nesting areas. If necessary, poisons, smoke devices, or sonar techniques may be implemented to control rodent populations.

Insect breeding areas, which may occur in areas of stagnant water, such as in bulky wastes and tires, or in areas of putrescible wastes, will be addressed as discovered. Dead animals will be covered at the end of each day to prevent the attraction of insects. Surface water control measures and liquid waste restriction will minimize the presence of standing water and the accumulation of water in bulky wastes. If insect infestations occur in spite of these measures, approved insecticides will be used.

2.11 Training and Safety Plan

Current landfill personnel annually attend a landfill operations course presented by the Solid Waste Association of North America (SWANA). The training includes hazardous waste identification and handling, as well as general site operations. All future landfill personnel will be required to attend this, or an equivalent course designed to train landfill operators. Training of landfill personnel is a continuing process which will also include basic first aid, safety training, equipment care, etc. Training will be documented and recorded for each course of instruction, and records will be kept current.

Communication via two-way radios and cell phones in each county vehicle are sufficient to enable contact with outside emergency services to protect the safety of personnel and users of the site. Phones are also available at the landfill shop on-site. Each County vehicle is equipped with a first aid kit. Depending on the severity of the injury, workers may treat themselves, call the Delta City Fire Department, or summon an ambulance. The injured worker is given discretion regarding whom to call and at what point. The operations manager or a County representative will be notified in the case of more severe injuries, and will ensure availability of appropriate medical care. If an emergency response team is called to the site, site personnel will complete a *Millard County Accident / Injury Report* form and record the date, time, type of injury, actions taken, response time of the emergency management service, and the time which the individual was evacuated from the site.

2.12 Recycling Program

Millard County currently does not have a curbside recycling program. As mentioned in Section 2.3, certain household hazardous wastes are currently being recycled by local businesses. Recycling of aluminum and newspaper occurs through voluntary community efforts. Junk automobiles, scrap metal, and white goods are stockpiled at the landfill for pickup by a licensed crusher/recycler. Until such time as a regional market for recyclable waste is established, Millard County will promote recycling through public education about product packaging and disposable goods.

2.13 Additional Operational Procedures

Several additional standards for maintenance and operation are required by UAC R315-303-5. Each of these operational standards is briefly discussed below. It is the responsibility of the operations manager to ensure that the facility is in full compliance with the standards of this regulation.

- *Dust Control* - The Landfill access road is paved from U.S. Highway 50 to the vicinity of the current landfill trench. A small segment of gravel road extends from the end of the access road to the active disposal area. The segment of gravel road is currently approximately 600 feet long. The road is scheduled to receive magnesium chloride treatment to prevent excessive generation of fugitive dust.

- *Open Burning* - Open burning is prohibited at the Millard County Landfill.

- *Litter Prevention* - a portable chain link fence surrounds the northern, southern, and eastern boundaries of the active trench. The fence serves to collect blown litter and debris. In addition, the landfill and surrounding areas are picked for litter on a regular basis by the Millard County Sheriff's Inmate Work Crew.

- *Scavenging* - Scavenging is prohibited at the Millard County Landfill.

- *Reclamation* - On-site reclamation will be conducted in an orderly, sanitary fashion, and will not interfere with site operations. Reclamation will be an ongoing process at the facility and will include general site grading over old trenches and possible revegetation of cut slopes around the perimeter access road, as needed.

- *Landfill Attendant* - There will be a minimum of one landfill attendant or equipment operator on-site at all time during normal operating hours.

- *Vector Control* - Vector control is described in Section 2.10 above.

- *Reserve Equipment* - The Millard County Landfill is run by Millard County and therefore is able to utilize equipment from other County departments in the event of an equipment breakdown.

- *Boundary Posts* - The entire permitted area is encompassed by a four-strand barbed-wire fence. The entrance to the landfill is clearly marked. The active trench area is bound on three sides by a chain link fence, and on the fourth side by a pile of excavated soil which stretches the length of the trench.

- *Compaction and Daily Cover* - Methods for the compaction of waste and the application of daily cover are described in Section 2.4.

- *Monitoring Systems* - Ground water monitoring systems are not included as part of the site design pursuant to the technical justification presented in an application for a waiver from ground water monitoring and liner requirements. This application was previously submitted to the Utah Department of Environmental Quality, and is included as Appendix E of this permit application. The gas monitoring program is defined in Section 7.5 of this report.

- *Recycling* - At this time recycling containers are not planned for the landfill facility. Several containers for common recyclable materials such as aluminum and newspaper are located throughout the City of Delta. At such time that a market

develops for additional recyclable materials, containers will be provided withing the City of Delta or at the landfill in accordance with UAC R315-303-5(6).

- *Hazardous Waste* - Hazardous waste is prohibited at the Millard County Landfill. The hazardous waste exclusion program for the facility is described in Section 2.3.9 of this application.

3.0 FINANCIAL ASSURANCE PLAN

Millard County, as the owner/operator of a solid waste disposal facility, has developed a Financial Assurance Plan as set forth in UAC R315-15-309. Millard County plans to place a final cover on the landfill twice during the sites estimated forty-year life. Closure activities will be performed when development of the site reaches the midway point and again when the site reaches full capacity. Although closure and post closure care costs will be paid only near or after the site reaches the midway point and after the date that the landfill stops accepting waste, the county reports a portion of these closure and post closure care costs as an operating expense in each period based on landfill capacity used as of each balance sheet date.

Part of the daily operation of the landfill includes excavation, compaction, and coverage such that, at the close of a given day, part of the cost of covering has already been met with that days operating expenses. Additionally, the county completes a designated trench prior to moving to the next trench; as one trench is filled and completed it is covered and contoured in such a manner as to comply with the majority of the final closure requirements. Therefore, much of the cost of closure and post closure will be met in the daily and annual operations of the site.

Costs of closure and post closure for the total county site has been estimated by Vector Engineering to be $483,200.00. An account has been established with the Utah Public Treasurers' Investment Fund (PTIF), Account # 2436. An annual installment of $20,000 is paid to the PTIF fund each year.

Actual life of the landfill is estimated at 60+ years if the fill continues at the current rate.

Current Closure Cost Estimate:	$593,754.00
Current Post-Closure Cost Estimate:	11,629.00
	$605,383.00
PTIF Fund Balance 30 Sep 2005	<$237,115.61>
	$368,267.39
Balance to be paid at $20,00 annual installments	÷20,000.00
	18.41 Years to meet financial assurance requirements

Financial Assurance for Closure/Post-Closure should be in place by the end of 2024.

4.0 CLOSURE PLAN

The Closure Plan has been developed in accordance with the Utah Administrative Code (R315-302-3). Closure of the Millard County landfill will be performed in accordance with this plan, and in such a manner as to:

- minimize the need for further maintenance;
- minimize or eliminate threats to human health and the environment from post-closure escape of solid waste constituents, leachate, landfill gases, contaminated run-off or waste decomposition products to the ground, ground water, surface water, or the atmosphere; and,
- adequately prepare the facility for the post-closure period.

This plan and any future alteration or amendments to this plan will be maintained with the operations plan for the facility at the Millard County Offices in Delta, Utah.

4.1 Elements of Closure

Millard County will perform final cover placement twice during the predicted 60-year active life of the site. Closure activities will be initiated when the development of the site reaches the location of the middle drainage, illustrated on attached Drawing C-1. As a result, the size of the area to be closed will encompass half of the 80-acre site, or approximately 40 acres. All equipment which will not be used on-site during the post-closure period will be removed. Structures at the site which remain after the final receipt of waste, and which will not be an integral part of post-closure site maintenance, will be dismantled and removed from the site. Any soil contamination remaining after the final receipt of waste will be removed, treated, or disposed of according to applicable regulations. Following the final receipt of waste, any remaining stockpiles of recyclable or other stored materials will be removed from the site.

Rough contouring will be performed throughout the life of the site during daily operations. Following the general site cleanup described above, final contouring will be performed using native soils to establish a suitable foundation for final cover construction. The site will be surveyed to establish base elevations for closure cap construction. After final grading of the foundation layer, the construction of the final cover layer will begin.

An 18-inch infiltration barrier layer will be installed according to UAC R315-303-4(4)(a), and will have a permeability equal to the permeability of the native soils. Following placement and compaction of the low permeability layer, the landfill will again be surveyed to verify a minimum infiltration barrier layer thickness of 18 inches, and final slope grades of at least two percent. The hydraulic conductivity of the low permeability layer will be field-tested and certified to be within acceptable limits. The testing will be performed as part of a Construction Quality Assurance (CQA) closure certification program. Material laboratory test work will be used to establish the field test criteria. The Closure Certification Report will include the material characteristics for the soil used

as the low permeability layer, as well as the procedures and results of the field methods used during the CQA Program. Preliminary field observations and laboratory analyses presented in the Vector (1994, appendix E) indicate that a sufficient volume of low permeability material exists on-site to construct the infiltration barrier layer.

Following the construction and certification of an approved infiltration barrier layer, a minimum of six inches of native soil will be placed over the infiltration barrier layer in accordance with UAC R315-303-4(4)(b). This six-inch layer will be capable of sustaining native plant growth and preventing excessive amounts of erosion. The layer will be seeded or hydro seeded with a seed mixture designed or recommended by a representative of the United States Department of Agriculture Soil Conservation Service.

Interior and exterior perimeter drainages or drainage diversions will be constructed as defined in Section 4.2 and illustrated on Drawing C-1 (Appendix I). The drainages will assist in maintaining the integrity of the final cover and preventing a washout of waste due to uncontrolled run-off during precipitation events. A final cover constructed in accordance with the design standards set forth in UAC R315-303-4, presented in Section 4.2 and illustrated in Drawing C-2 (Appendix I), will be sufficient to prevent the infiltration of surface waters through the underlying waste mass.

4.2 Closure Design

The final cover will be constructed in accordance with UAC R315-303-4(4)(a). The final cover will consist of an 18-inch low permeability infiltration layer and a six-inch erosion layer. The infiltration layer will have a permeability equal to the permeability of the natural subsurface soils beneath the landfill. The six-inch erosion layer will consist of on-site soils capable of sustaining native plant growth. The final cover layer will be revegetated with native grasses according to a plan developed or recommended by a representative of the U.S.D.A. Soil Conservation Service. The final cover will be graded so as to prevent ponding and minimize infiltration of run-off waters.

The closure design is illustrated on Drawings C-1, C-2 and C-3 (Appendix I). The entire 80-acre site is included in the closure design. As described above, the largest area to be covered at any time will be approximately 40 acres, or half of the site. Due to the relatively flat topography surround the facility, the final topography of the closed landfill was designed to minimize the vertical rise of the closure surface while maintaining a minimum grade of two percent on all slopes. As illustrated on Drawing C-1 (Appendix I), the design consists of three parallel ridges trending east-west across the site. The ridge side slopes will be graded at a minimum of two percent into two internal drainage swales and a perimeter drainage channel.

Drainage channels were sized to accommodate the flow from a 25-year, 24-hour storm event. A detailed discussion of site hydrology and hydraulics is included in Section 7.0 of this application, and the drainage report presented in Appendix H. The internal drainage swales and interior perimeter channel will grade at approximately one percent downhill and to the west. The two

internal drainage swales are intercepted halfway across the site by the middle drainage, which will direct run-off water from the final closed surface south down the middle and off-site. A detail and schematic cross sections of the middle drainage channel are included on Drawing D-1 (Appendix I). A drainage channel will be constructed around the interior perimeter of the closed area, inside the perimeter access road. Three culverts will be installed in strategic locations to direct run-off from the closed surface of the landfill away from the site. A 24-inch corrugated metal pipe culvert (culvert #3) will route flow from the middle drainage channel under the perimeter access road and off-site to the south. Two additional culverts (culverts #1 and #2) will direct run-off from the western half of the site under the perimeter access road and into natural drainages off-site.

An exterior perimeter drainage channel, outside the perimeter access road, will be constructed along the northern and eastern site boundary. This will intercept any potential run-on flow and redirect it around the closure cap and off of the site. As illustrated on Drawing C-1 (Appendix I), run-on flow will be redirected from the site into adjacent natural drainages. The exterior perimeter drainage will be constructed coincident with the phased construction of the trenches throughout the life of the facility.

4.3 Site Capacity

The Millard County Landfill utilizes excavated trenches for waste disposal. The trenches are excavated parallel to each other, and are aligned in a north-south direction. Each trench is approximately 1,000 feet long, 60 feet wide, and 25 feet deep. The trenches typically can be utilized for approximately three years. Current operating plans are to excavate the trenches successively from east to west across the property. Millard County is currently filling the seventh trench to be excavated since the opening of the landfill in 1989. The existing trenches are separated by approximately ten feet of native soil. In order to estimate the expected active life of the site, the following assumptions are made:

- each trench is 1,000 feet long, 60 feet wide, and 25 feet deep;
- uncompacted waste density is 300 lbs./yd^3;
- waste is compacted to 1,000 lbs./yd^3;
- waste to soil ratio is 4:1;
- soil is compacted 10%; and,
- trenches are separated by approximately 10 feet of native soil.

Loading rate calculations based on these assumptions are included in appendix F. Twenty-year growth projections for the county were obtained from the Millard County solid Waste management Plan (Stansbury, 1993). The calculations indicate approximately five trenches will be required through the 2012. Assuming a conservative final trench width of 80 feet, separated by 30 feet of native soil, 22 additional trenches can be excavated between the existing trench and the western site boundary. Based on the current trench size and capacity, the remaining undisturbed portion of the site will hold a total disposal volume of waste and cover soil of approximately 1,222,210 cubic yards. A graph of the cumulative disposal volume over time is also presented in

appendix F. Using the slope of the curve, representing the projected growth in waste disposal volume for the years 1992 to 2012, to project the growth of the waste stream farther into the future, it will take approximately 44 years to reach a remaining site capacity of 1,222,210 cubic yards. The remaining capacity of the site (1,222,210 cubic yards) includes 977,768 yd^3 of waste and 244,442 yd^3 of soil. This volume of waste, compacted at 1,000 lbs./yd^3, is equivalent 488,884 tons of waste. Based on these data, was reasonable to predict a conservative site life of 60 years.

*Based on the data in the application, with trenches being separated by 10 feet of native soil (rather than the original design of 30 feet between trenches), it is currently reasonable to predict a conservative site life of **60** years or more.

4.4 Closure Schedule

At least 60 days before the projected final receipt of waste, Millard County will notify the Executive Secretary of the intent to close the landfill and implement the closure plan. Within thirty (30) days after the final receipt of waste, Millard County will initiate implementation of the closure plan. The closure activities described in this plan will be completed within 180 days of initiation. Following the completion of closure activities, Millard County will submit to the Executive Secretary a set of as-built drawings of final closure construction signed by a professional engineer registered in the State of Utah. Millard County will also provide certification of the compliance of final closure construction with the approved closure plan. The certification will be signed by a representative of Millard County and a professional engineer registered in the State of Utah.

4.5 Closure Costs

The closure cost estimate, detailed in Table 4.1 below, has been prepared utilizing Appendix G of the Solid Waste Permitting and Management Rules as a general guideline. According to the proposed Closure Plan, the largest area requiring closure at any time will be approximately ~~40~~ acres. The cost estimate has been prepared using reasonable estimates of unit costs based on 1995 dollars. A ten percent contingency has been built into the final estimate to account for variances in unit costs and any possible unforseen circumstances. Due to the large volume of water which will be necessary to compact the native soils to the appropriate permeability, it may be necessary and economical to install a well at the landfill for the express purpose of supplying construction water. An estimate of the cost for a well installation has been included in the closure cost estimate. A comprehensive financial assurance document has been prepared by Millard County submitted to the Executive Secretary on February 23, 1996. Projections of fund withdrawals were also included in the financial assurance document.

TABLE 4.1
CLOSURE COST ESTIMATE
Millard County Landfill

ITEM	UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST	Source	Notes
1. Topographic Survey	day	$622/day	5	$ 3,110	Estimated cost as percent of closure construction	Reflects current rate of inflation from $2,500 figure received from Vector Engineering in 1995, page 25, original permit application.
2. Contract Administration, Bidding Award	lump sum	10% total	1	$ 48,523	Estimated cost as percent of closure construction	Reflects current rate of inflation from $39,000 figure received from Vector Engineering in 1995, page 25, original permit application.
3. Administrative Costs for Final Cover Certification	day	$871/day	4	$ 3,484	Estimated cost as percent of closure construction	Reflects current rate of inflation from $700 per day or a total of $2,800 figure received from Vector Engineering in 1995, page 25, original permit application.
4. Project Management, /Closure Quality Assurance	acre	$1,244/acre	40	$ 49,760	Estimated cost as percent of closure construction	Reflects current rate of inflation from $1,000 per acre or a total of $40,000 figure received from Vector Engineering in 1995, page 25, original permit application.
Engineering Subtotal				**$ 104,877**		Reflects current rate of inflation from $84,300 figure received from Vector Engineering in 1995, page 25, original permit application.
5. Infiltration Layer Placement	cy	$3.42/cy	95,000	$ 324,900	Estimated cost as percent of closure construction	Reflects current rate of inflation from $2.75 per cubic yard or a total of $261,250 figure received from Vector Engineering in 1995, page 25, original permit application.
7. Erosion Layer Placement	cy	$1.87/cy	32,300	$ 60,401	Estimated cost as percent of closure construction	Reflects current rate of inflation from $1.50 per cubic yard or a total of $48,450 figure received from Vector Engineering in 1995, page 25, original permit application.
8. Revegetation	acre	$156/acre	40	$ 6,240	Estimated cost as percent of closure construction	Reflects current rate of inflation from $125 per acre or a total of $5,000 figure received from Vector Engineering in 1995, page 25, original permit application.
9. Site Grading & Drainage	acre	$622/acre	40	$ 24,880	Estimated cost as percent of closure construction	Reflects current rate of inflation from $500 per acre or a total of $20,000 figure received from Vector Engineering in 1995, page 25, original permit application.
Construction Subtotal				**$ 416,421**		
3% Performance bond				$ 18,478		
Subtotal				$ 539,776		
10% Contingency				$ 53,978		
TOTAL				**$ 593,754**		

*The original table listed well installation at a cost of $10,000. The well was installed in 2001

4.6 Final Inspection

Following the completion of closure activities, a final report will be prepared and certified by an engineer registered in the State of Utah. The report will present laboratory and field test data which support the conformance of the final cover installation and closure activities with the Utah Solid Waste regulations and the approved Closure Plan. The report will also include facility closure plan sheets signed by a professional engineer registered in the State of Utah which represent the final, as-built closure construction. The Executive Secretary will be notified of the completion of closure activities and arrangements will be made for a final inspection by UDEQ. Following final approval by UDEQ, the post-closure maintenance plan will be initiated pursuant to the approved Post-Closure Plan, outlined in Section 5.0 of this permit application.

5.0 POST-CLOSURE PLAN

The Post-Closure Plan has been developed in accordance with UAC R315-302-3. Post-closure care and maintenance of the Millard county Landfill will be performed in accordance with this plan, which provides for continued facility maintenance and landfill gas monitoring. The design of the Millard County landfill does not include a ground water monitoring or leachate collection system, and surface water is not present within two miles of the site. Therefore, the post-closure plan does not include ground or surface water monitoring. The office listed below may be contacted during the post-closure period regarding issued which concern the landfill property:

Millard County Commission Coordinator - Landfill
Millard County Offices
71 South 200 West, PO Box 854
Delta, UT 84624
(435) 864-1400

5.1 Monitoring

This permit application is submitted without provision for ground water monitoring, surface water monitoring, or leachate collection or treatment systems. Exclusion of these items is based on the technical justification documented in Appendix E (Vector, 1994).

Landfill gas monitoring will be continued on a quarterly basis during the post-closure period at all monitoring points established throughout the life of the facility. If the results of continued monitoring at the facility indicate that the site has stabilized and does not pose a threat to human health or the environment, the owner or operator may petition the Executive Secretary for a decrease in the length of the post-closure monitoring period.

5.2 Maintenance Activities

Following closure of the Millard County landfill, the final cover and drainage systems will be inspected at least annually by personnel from Millard County. The final cover and drainage system will be examined for the effects of erosion, subsidence, settlement, or other events which may compromise the integrity of the final cover or the effectiveness of the drainage system. Necessary repairs will be completed as soon as is practicable following each inspection in order to maintain the effectiveness of the drainage system and restore the integrity of the final cover. The site perimeter fence will also be inspected during annual inspection.

5.3 Post-Closure Schedule

Post-closure activities will be initiated immediately following the completion of the closure activities described in Section 4.0 of this application. Post-closure activities will continue for a period of thirty years or a period established by the Executive Secretary. If post-closure monitoring activities indicate that the site has stabilized and does not pose a threat to human health or the environment, Millard County will petition the Executive Secretary for a decrease in the length of the post-closure monitoring period.

Upon completion of post-closure monitoring activities as determined by the Executive Secretary, Millard County will submit to the Executive Secretary a certification, signed by the county and a professional engineer registered in the State of Utah, which states why post-closure activities are no longer necessary. Following final approval by the Executive Secretary, post-closure monitoring activities will be discontinued.

5.4 Record Modifications

Within 60 days after the completion of all closure activities, plats and a statement of fact concerning the location of any disposal site shall be recorded as part of the record of title with the Millard County Recorder. The notation will serve to notify any potential purchaser of the property that the land has been used as a landfill, and that its use may be restricted by local land use or zoning regulations. Millard County will notify the Executive Secretary that the deed notation has been recorded.

5.5 Post-Closure Costs

The following post-closure cost estimate has been prepared utilizing Appendix G of the Utah State Solid Waste Permitting and management Rules. Some of the assumptions used to derive the cost estimate included annual inspections of the integrity of the final cover and general site condition, and semiannual monitoring for landfill gas. In addition, the cost estimate was calculated assuming a third-party would perform the inspections and monitoring. The cost estimate for annual post-closure care is presented in detail in Table 5.1 below, and is based on 1995 dollars. A ten percent contingency has been built into the cost estimate. Projected fund withdrawals to support post-closure activities will be discussed in the financial assurance document.

TABLE 5.1
COST ESTIMATE FOR ANNUAL POST-CLOSURE CARE
Millard County Landfill

ITEM	UNIT MEASURE	COST/UNIT	NO. UNITS	TOTAL COST	Source	Notes
1. Site Inspection and Record Keeping	hour	$19/hour	40	$ 760	Estimated cost as percent of closure construction	Reflects current rate of inflation from $15 per hour or a total of $600 figure received from Vector Engineering in 1995, page 28, original permit application.
2. Correctional Plans and Specifications	hour	$93/hour	20	$ 1,860	Estimated cost as percent of closure construction	Reflects current rate of inflation from $75 pe hour or a total of $1,500 figure received from Vector Engineering in 1995, page 28, original permit application.
Landfill Gas Monitoring	event	$1,244/event	4	$ 4,976	Estimated cost as percent of closure construction	Reflects current rate of inflation from $1,000 per event or a total of $4,000 figure received from Vector Engineering in 1995, page 28, original permit application.
Maintenance Construction	hour	$93/hour	32	$ 2,976	Estimated cost as percent of closure construction	Reflects current rate of inflation from $75 per hour or a total of $2,400 figure received from Vector Engineering in 1995, page 28, original permit application.
Subtotal				$ 10,572		
10% Contingency				$ 1,057		
TOTAL				**$11,629**		

NOTE: Based on annual site inspections and quarterly gas monitoring.

PART III - TECHNICAL DATA

6.0 GEOHYDROLOGICAL ASSESSMENT

The majority of the requirements of UAC R315-310-4(2)(b) are addressed in the document *Application for a Waiver from Ground Water Monitoring and Liner Requirements at the Millard County Landfill* (Vector, 1994), submitted to the Utah Department of Environmental Quality in November of 1994, the subsequent *Request for Addition Information* from UDEQ, and the *Response to Request for Additional Information* submitted to UDEQ by Millard County. The waiver application and related correspondence with the Utah Department of Environmental Quality are included in Appendix E, and are considered integral parts of this permit application. The waiver application (Vector, 1994) addresses the following elements of a geohydrological assessment, as defined by UAC R315-310-4(2)(b):

- local and regional geology and hydrology;
- evaluation of soil types and properties, including permeability rates;
- depths to ground water or aquifers;
- direction off ground water flow; and,
- calculation of site water balance using HELP model.

The reader is referred to the document (Appendix E) for detailed discussions of these elements of the Geohydrological Assessment. The remaining requirements of a geohydrological assessment, address below, include the following:

- faults, unstable slopes, and subsidence areas on-site;
- quantity, location, and construction of any private and public wells on the site and within a 2,000 foot radius of the site;
- tabulation of all water rights for ground and surface water on the site and within a 2,000 foot radius of the site;
- identification and description of all surface waters on the site and within a one-mile radius of the site;
- background ground and surface water quality assessment; and,
- conceptual design of ground and surface water monitoring systems.

6.1 Faults, Unstable Slopes, and Subsidence Areas

Geologic coverage of the landfill area is provided at a scale of 1:250,000 by Hintze (1963). As abstracted from Hintze's (1963) map, the landfill area is dominated by Quaternary alluvial and eolian sediments. Hintze (1963) did not identify any faults in the area surrounding the landfill. In addition, the U.S. Geological Survey map MF-916 *(Preliminary Map of Young Faults in the United States as a Guide to Possible Fault Activity)* does not indicate the present of Holocene faulting in the vicinity of the Millard county Landfill. A study by Christenson and Nava (1992) indicates that the nearest fault with evidence of movement in Holocene time is more than 10 miles west of the landfill. An additional study by Anderson and Miller

(1979) places the nearest Quaternary fault over six miles south of the landfill. Additional faults were not identified in the landfill area.

Soils beneath the landfill property are characterized by dense silts and stiff to very stiff clays. No expansive soils are known to exist anywhere on the property. No subsidence has been observed in the areas of the two completed landfill trenches, either by soil settlement due to the overlying waste load, or due to settlement within the waste mass itself.

A study by Mulvey (1992) *entitled Engineering Geologic Problems Caused by Soil and Rock in Southwestern Utah* provides a generalized map of the distribution of problem soil and rock in southwester Utah. The study defines six types of problem soil or rock found in southwestern Utah: expansive soil or rock; collapsible soil; gypsiferous soil or rock; limestone (karst); soils susceptible to piping; and, areas which contain active dunes. None of these soil or rock types are identified by Mulvey (1992) in the area of the Millard County Landfill. There are no steep slopes or bedrock outcrops in the vicinity of the landfill. The nearest lithologic unit which has been characterized as unstable slope having the potential for mass-wasting lies approximately 40 miles south of the site (Harty, 1992). A map of landslides in southwester Utah by Harty (1992) shows the nearest landslide to be more than 10 miles northeast of the landfill.

6.2 Wells, Water Rights, and Surface Water

File searches by the State of Utah Division of Water Rights did not disclose the presence of any water rights or existing or abandoned wells within a 2,000 foot radius of the landfill site. A copy of the correspondence from the Division of Water Rights is included as Appendix G of this permit application.

Surface water is not present within a one-mile radius of the site; however, several small, ephemeral drainages are located within one mile of the landfill. These drainages, by definition, carry water only during periods of heavy precipitation, and then only for short durations. All potential surface water in the form of run-off, whether confined to ephemeral drainages or occurring as sheetflow, will be redirected around the landfill property as described in Section 7.6 of this report. Any waters which are redirected around the site will not come into contact with any possible contaminants resulting from the operation of the landfill. Therefore, no surface water is threatened by the location of the Millard County Landfill.

6.3 Ground and Surface Water Quality

Surface water is not present within the vicinity of the landfill property. There are two wells within two miles of the landfill which have recorded chemical data for ground water. At the time of the original application in 1995, the closest well, identified as 26daa-3 by Enright and Holmes (1982), was located approximately one mile southwest of the landfill. An additional well for which published data exists is located up-gradient from and approximately two miles directly north of the landfill. This well was identified by Mower and Feltis (1964) as 12dad-1. Chemical data for the northern well (12dad-1), collared at an elevation 4,626 feet (MSL) and completed to a depth of 720 feet, are available from analyses performed in 1962. Chemical data for the closer well southwest of the landfill (26daa-3), collared at the elevation of 4,634 feet (MSL), are available from the 1978 (Enright and Holmes, 1982). The depth of well 12dad-1 is unknown. The chemical data for each of these wells are summarized in Table 6.1, and are derived from published data

by Enright and Holmes (1982), and Mower and Feltis (1964). There are now two industrial dairies within one mile of the landfill which were not there at the time of the original landfill permit application.

6.4 Ground and Surface Water Monitoring Systems

The requirements of a geohydrological assessment, as defined by UAC R315-310-4(2)(b), call for a conceptual design of ground and surface water monitoring systems, including proposed installation methods and a vadose zone monitoring plan, where required. This permit application is submitted without provisions for a liner, ground water, surface water, or vadose zone monitoring system. The exclusion of these provisions is supported by the technical justification previous submitted to UDEQ in Vector (1994). The waiver application and related correspondence from UDEQ are included in Appendix E of this application.

Table 6.1 - Ground Water Chemistry

Well Location	(C-17-6) 12dad-1*	(C-17-6) 26daa-3**
Sample Date	11/27/62	06/26/78
Temperature	-	21
Sp. Conductance (µmhos)	1090	630
pH	7.3	7.6
Hardness (mg/L as $CaCO_3$)	316	140
Hardness - Noncarbonate (mg/L as $CaCO_3$)	41	0
CALCIUM -dissolved (mg/L as Ca)	34	27
MAGNESIUM - dissolved (mg/L as Mg)	56	18
SODIUM - dissolved (mg/L as Na)	-	73
POTASSIUM - dissolved (mg/L as K)	-	18
Na + K - dissolved (mg/L as Na)	108	-
BORON - dissolved (µ/L as B)	-	290
MANGANESE - dissolved (µg/L as Mn)	-	<10
ALKALINITY FIELD (mg/L as $CaCO_3$)	-	220
SULFATE - dissolved (mg/L as SO_4)	51	40
CHLORIDE - dissolved (mg/L as CI)	151	41
FLUORIDE - dissolved (mg/L as F)	-	1.6
SILICA - dissolved (mg/L as SiO_2)	56	59
SOLIDS - Sum of constituents - dissolved (mg/L)	634	413
NITROGEN, NO_2+nO_3 - dissolved (mg/L)	-	0.34
ARSENIC - dissolved (µg/L as As)	-	-

* ground water chemistry data from mower and Feltis (1964)
** ground water chemistry data from Enright & Holmes (1982)

7.0 ENGINEERING REPORT

This engineering report has been prepared in accordance with R315-310-4(2)(c) of the Utah Administrative Code (UAC).

7.1 Maps, Drawings, and Specifications

All maps and drawings are included in Appendix I of this permit application. Drawing a-1 is a title sheet and vicinity map for the Millard County Landfill. Drawing B-1 is an original copy of the United States Geological Survey Harding, Utah 7.5 Minute topographic quadrangle map. The map has been modified to show the property and facility boundary, the zoning and land use designation of the surrounding area, the latitude and longitude of the facility entrance, and the direction of the prevailing winds. At the time of the original application, there were no existing utilities or structures within one quarter mile of the site, with the exception of the maintenance/storage shed located on-site and illustrated in Drawing B-2. There is now a three-bay shop/office landfill building, along with a well and pump house, near the entrance of the facility which is owned by Millard County. There are also two industrial dairies located within ½ mile of the landfill site.

- *Drawing B-2* illustrates the existing topography of the site and the existing and proposed facilities. The topographic base map was generated from a ground survey performed by Sunrise Engineering, Inc. for Millard County.
- *Drawing B-3* shows the location of structure and well built in 2001.
- *Drawing C-1* presents the conceptual closure design for the Millard County Landfill
- *Drawings C-2 and C-3* illustrate several cross sections of the conceptual closure surface. The location of each cross section is indicated on Drawing C-1.
- *Drawing D-1* presents specific details of existing and proposed facilities.

It should be noted that the topography and design of the trench presented in Drawings B-2, C-1, and detail C on Drawing D-1 are shown as-built as part of the current operations conducted by Millard County. A slope stability analysis was not performed as part of the site design presented in these drawings.

7.2 Location Standards

UAC R315-302-1 mandates that all applicable solid waste facilities are subject to certain restrictions regarding the location of the facility. The Millard County Landfill is an existing facility, and is therefore not subject to most of the location restrictions defined in UAC R315-302-1. UAC R315-302-1(3) mandates that existing facilities must meet the location restrictions pertaining to airports, flood plains, and unstable areas,

or must close by October 9, 1996. The compatibility of the existing site with respect to these restrictions is discussed below.

7.2.1 Airports

The Millard County Landfill is not located within ten thousand feet of an airport runway end. The nearest airport is located more than three miles northwest of the landfill near Delta City, Utah.

7.2.2 Floodplains

A review of the U.S. Department of Housing and Urban Development FEMA Community Panel Maps for Millard County unincorporated areas (FEMA, 1987) indicates that the flood hazard of the Landfill area has not been determined. As a result, an investigation of site geology, geomorphology and topography was undertaken in accordance with recommendations contained in the U.S. Environmental Protection Agency publication entitled *Draft Technical Manual for Solid Waste Disposal Facility Criteria - 40 CFR part 258* (U.S. EPA, 1992). According to UAC R315-301-1(23), "floodplain" means "the land which has been or may be hereafter covered by floodwater which has a 1% chance of occurring any given year. The flood is also referred to as the base flood, or 100-yer flood." Review of the U.S. Geological Survey topographic map (Drawing B-1, Appendix I) of the area indicates an absence of surface water, streams, springs, or seeps within a 3000-foot radius of the landfill site. Three are no large washes or drainages which either intersect or lie uphill of the landfill property. The U.S. EPA's *Draft Technical Manual* (U.S. EPA, 1992) identifies floodplains as flat areas adjacent to a river's normal channel, represented by sedimentary deposits formed by floods that have a one percent chance of occurrence in a 100-year period. The area surrounding the Millard County Landfill does not meet the definition of a floodplain as described in UAC R315-301-1-(23) and the E.P.A. *Draft Technical Manual* (U.S. EPA, 1992).

7.2.3 Unstable Areas

UAC R315-302-1(2)(b)(iii) requires that the owner or operator of an existing facility, a lateral expansion of an existing facility, or a new facility must demonstrate that engineering measures have been incorporated into the design of the facility to ensure that the integrity of the structural components of the facility will be disrupted. This demonstration must consider the following:

- on-site or local soil conditions that may result in significant differential settling;
- on-site or local geologic or geomorphologic features; and,
- on-site or local human-made features or events, both surface and subsurface.

A field investigation was undertaken in the development of the waiver application (Vector, 1994, Appendix E) and included a subsurface drilling and sampling program. Information obtained during the investigation indicates that the soils beneath the landfill property are characterized by dense silts and stiff to very stiff clays. No expansive soils are known to exist anywhere on the property. Subsidence has not been observed in the areas of the two completed landfill trenches, either by soil settlement due to the overlying waste load, or due to settlement within the waste mass itself.

As discussed in Section 6.1, a study by Mulvey (1992) indicates that there is no problem soil or rock in the vicinity of the landfill. There are no dammed bodies of water up-gradient from the landfill. There are no underground mines in the vicinity. In addition, on-site subsurface exploration and a review of available geologic literature did not reveal the presence of salt domes or beds in the area of the landfill. There are no slopes or bedrock outcroppings in the vicinity of the landfill. The nearest lithologic unit which has been characterized as having the potential for mass-wasting lies approximately 40 miles south of the site (Harty, 1992). A map of landslides in southwestern Utah (Harty, 1992) shows that the nearest landslide is greater than 10 miles northeast of the landfill. Based on this information, the Millard County landfill satisfies the location restrictions defined in UAC R315-302-1(3).

7.3 Design and Operation

As illustrated in Drawing B-2 (Appendix I), the Millard County Landfill consists of a series of trenches aligned in a north-south direction and progressing from east to west across the property. Each trench is approximately 1,000 feet long, 25 feet deep, and 60 feet wide. Total volumetric capacity of each trench is approximately 55,500 cubic yards. The current trench configuration was developed by Millard County and is depicted "as-built" in all drawings. The sidewall slope angles of the trenches are approximately 75 to 80 degrees from horizontal. A ramp is provided at the active end and center of each trench for access by landfill equipment.

Daily operations begin with the receipt of incoming waste at the southern end of the active trench. Near the end of the operating day, the waste is spread and compacted in thin layers less than two feet in thickness. Daily cover material is subsequently retrieved from nearby stockpiles and spread over the waste layers to a minimum, thickness of six inches.

As mentioned in the Plan of Operation, a daily cover material is derived from soil stockpiles generated during trench excavation. As each trench is excavated, soil is stockpiled over the previously completed trench, reaching thicknesses of up to 15 feet in places. As the operation of the new trench processes, cover soil is obtained from these stockpiles for use as daily cover. The thickness of cover over each previous trench is maintained at a minimum of two feet, and will act as an interim cover during the active life of the facility. In addition, the raised surface of the interim cover over the relatively flat topography of the area will redirect any potential run-on flow around and away from the active trench area. Contouring of the inactive portions of the landfill will be a continuing process throughout the life of the facility in preparation for the placement of the final cover. Re-contoured areas of the landfill will be periodically revegetated during the life of the facility in order to reduce the volume and velocity of run-off flows. These activities are further discussed in Section 7.6 below. A final revegetation plan will be executed following the installation of a final cover at the end of the active life.

7.4 Ground Water Monitoring, Leachate Collection, and Leachate Treatment Systems

Based on the *Application for a Waiver from Ground Water Monitoring and Liner Requirements at the Millard County Landfill* (Vector, 1994), submitted to the Utah Department of Environmental Quality on

November 4, 1994 and included with the original application as Appendix E, this permit application is submitted for approval of continued operations without ground water monitoring, leachate collection, or leachate treatment system.

7.5 Landfill Gas Control and Monitoring

Landfill gas monitoring is performed at the site on a quarterly basis and will continue during the active life of the facility. Because of the relatively low permeability and transmissivity of the soils which underlie the site, gas monitoring wells are not proposed. Instead, specified locations around the site are analyzed utilizing a hand-held detector which is capable of detecting the concentration of landfill gas in the air. The instrument is capable of determining if landfill gas has exceeded 25% of its lower explosive limit at each measuring point. If landfill gas analysis detects a concentration in excess of 25% of the lower explosive limit (LEL), the contingency plan described in 2.8.3 will be initiated. Initial gas monitoring locations are illustrated on Drawing B-2 (Appendix I) and include monitoring points around the site perimeter, near the active face, around old fill areas, and inside the on-site maintenance/storage building. Additional monitoring points will be added as the facility expands. To date no detectable amounts of gas have been detected.

7.6 Run-on/Run-off Control Systems

Run-on controls during the active life of the facility will include the gradual construction of exterior perimeter drainages along the eastern and north property boundaries. The drainages will be approximately 18 inches deep, with 2:1 side slopes, and will direct potential run-on flows around the property boundary. A V-ditch of this size, over the relatively flat grades in the vicinity of the landfill, is capable of transporting more than 18 cubic feet of water per second, sufficient to accommodate expected run-on flows. As discussed in Section 7.3 above, excess excavated native soil will act as an interim cover over inactive portions of the landfill. The added thickness of the interim cover, maintained at a minimum thickness of two feet over the relatively flat local topography, will act as a diversion berm for potential run-on flows because the filled and covered portions of the landfill will always be located up-slope from the active trench. An additional temporary diversion berm will be constructed on the up-slope side of each active trench. This will redirect potential run-on flows that are generated within the site boundaries, up-slope from the active trench. As a result of the combination of these run-on control features, the amount of water entering the active trench will be restricted to direct precipitation.

Run-off control systems are not proposed for the facility during the active life of the site. All precipitation or surface water which comes into contact with waste will be contained within the active disposal trench. Run-off generated within the property boundary and east of the active trench will be directed around the active trench by the temporary diversion berm described above.

The run-off control systems proposed for the Millard County Landfill for the post-closure period, illustrated on Drawing C-1 (Appendix I), have been designed to control and redirect the flow resulting from a 25-year, 24-hour storm event. A drainage report has been prepared for the landfill site and addresses drainage conditions under existing and closed surface conditions. The drainage report is included with this

application as Appendix H. Although shown on Drawing B-2 as part of the facility's run-on/run-off control system, the interior perimeter drainage will not be constructed until final closure activities are initiated.

As mentioned in the Closure Plan (Section 4.0), the final configuration of the closed landfill includes three parallel ridges running east-west across the property, separated by two interior drainage swales. Flows from the interior drainage swales are directed into an interior perimeter drainage channel and routed off-site. The internal drainage swales and interior perimeter channel will grade at approximately one percent downhill and to the west. The two internal drainage swales are intercepted halfway across the site by the middle drainage which will direct run-off water from the final closed surface south down the middle and off-site. A detail and cross sections of the middle drainage channel are included on Drawing C-2 (Appendix I). A 24-inch corrugated metal pipe culvert (culvert #3) will route flow from the middle drainage channel under the perimeter access road off-site to the south. Run-off flows from the western half of the property will flow from the drainage swales into the interior perimeter drainage channel, and then off-site through culverts #1 and #2, as illustrated on Drawing C-1. Culverts #1 and #2 are also designed as 24-inch corrugated metal pipes.

An exterior perimeter drainage channel will be constructed during the active life of the facility along the northern and eastern site boundary. The drainage will intercept any potential run-on flow and redirect it around the closure cap and off-site. As illustrated on Drawing C-1 (Appendix I), run-on flow will be redirected off-site into adjacent natural drainages.

7.7 Closure and Post-Closure Design, Construction, and Maintenance

A detailed discussion of closure and post-closure design, construction, and maintenance is included in Sections 4.0 and 5.0 of this application. The post-closure land use of the property, because of its remote location, is likely to be open range. However, the perimeter fence will remain in place until the completion of the post-closure care period.

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APPENDIX A
Current Operating Permit

UTAH SOLID AND HAZARDOUS WASTE CONTROL BOARD
SOLID WASTE PERMIT

CLASS I LANDFILL

Pursuant to the provisions of the *Utah Solid and Hazardous Waste Act*, Title 19, Chapter 6, Utah Code Annotated (UCA) 1953, as amended (the Act) and the *Utah Solid Waste Permitting and Management Rules*, Utah Administrative Code (UAC) R315-301 through 320 adopted thereunder,

MILLARD COUNTY

is hereby authorized to operate the **Millard County Class I Landfill** located in North ½, of the Southeast 1/4, Section 24, Township 17 South, Range 6 West, Salt Lake Base and Meridian, Millard County, Utah as shown in the permit application dated December 1, 1995 and amended October 2, 2000. (Lat. 39° 19' 14" N, Long. 112° 28' 17" W)

The operation of the landfill is subject to the condition that Millard County (Permittee) meet the requirements set forth herein.

All references to UAC R315-301 through 320 are to regulations that are in effect on the date that this permit becomes effective. If changes are made in UAC R315-301 through 320 that affect the operation or activities at the landfill, the changes shall become effective on the landfill 180 days following the effective date of the rule or upon a compliance schedule as established for the landfill by the Executive Secretary.

This permit shall become effective April 1, 2001.

This permit shall expire at midnight March 31, 2006.

Signed this 5th day of March, 2001.

Dennis R. Downs, Executive Secretary
Utah Solid and Hazardous Waste Control Board

PERMIT REQUIREMENTS

NAME:	Millard County Class I Landfill
ADDRESS:	Sheryl Dekker, Operations Manager 71 South 200 West Delta, Utah 84624 Telephone: 435-864-1400
TYPE OF PERMIT:	Class I Landfill
PERMIT NUMBER:	9431R1
LOCATION:	The **Millard County Class I Landfill** located in North ½, of the Southeast 1/4, Section 24, Township 17 South, Range 6 West, Salt Lake Base and Meridian, Millard County, Utah as shown in the permit application dated December 1, 1995 and amended October 2, 2000. (Lat. 39° 19' 14" N, Long. 112° 28' 17" W)

Permit as used in this document is defined in Utah Administrative Code (UAC) R315-301-2(54).

The applications, consisting of the application received January 12, 1996 and the renewal application received October 6, 2000 as amended by materials received November 9, 2000, were deemed complete on December 21, 2000, are hereby approved and are incorporated by reference into this Solid Waste Permit. All representations made in the permit application are part of this permit and are enforceable under UAC 315-301-5(2). The permit application will become part of the operating record of the Landfill. Where differences in wording exist between this permit and the application, the wording of the permit supersedes that of the application.

By this permit to operate, the Permittee is subject to the following conditions.

I. GENERAL COMPLIANCE RESPONSIBILITIES

A. General Operation

The Permittee shall operate the Class I Landfill in accordance with all applicable requirements of UAC R315-302 and 303, for a Class I Landfill, that are currently effective unless otherwise noted in this permit. Any permit noncompliance or other noncompliance constitutes a violation of UAC R315-302 or 303 and is

grounds for appropriate enforcement action, permit termination, modification, or denial of a permit renewal application.

B. Acceptable Waste

This permit is for the disposal of nonhazardous solid waste which may include, municipal solid waste, commercial waste, industrial waste, construction/demolition waste, and special waste.

C. Prohibited Waste

No hazardous waste as defined by UAC R315-1 and R315-2, except waste specified by UAC R315-303-4(7)(a)(i)(B); or PCB's as defined by UAC R315-301(52), except those specified by UAC R315-315-7(2), may be accepted for storage, treatment, or disposal at the landfill. Any prohibited waste received and accepted for storage, treatment, or disposal at the facility will constitute a violation of this permit and UAC R315-303-4(7).

D. Inspections and Inspection Access

The Permittee shall allow the Executive Secretary of the Utah Solid and Hazardous Waste Control Board or an authorized representative, including representatives from the Central Utah Public Health Department, to enter at reasonable times and:

1. Inspect the landfill or other premises, practices or operations regulated or required under the terms and conditions of this Permit or UAC R315-301 through 320;

2. Have access to and copy any records required to be kept under the terms and conditions of the Permit or UAC R315-301 through 320;

3. Inspect any loads of waste, treatment, pollution management, or control facilities required under the Permit or regulated under UAC R315-301 through 320; and

4. Obtain a record of any inspection by photographic, videotape, electronic, or other reasonable means.

E. Noncompliance

1. If monitoring, inspection, or testing indicates that any permit condition or any applicable rule under UAC R315-301 through 320 may be or is being

violated, the Permittee shall promptly make corrections to the operation or other activities to bring the facility into compliance with all permit conditions or rules. In the event of any noncompliance with any permit condition or violation of an applicable rule, the Permittee shall promptly take any feasible action reasonably necessary to correct the noncompliance or violation and mitigate any risk to the human health or the environment. Actions may include eliminating the activity causing the noncompliance or violation and containment of any waste or contamination using barriers or access restrictions, placing of warning signs, or permanently closing areas of the facility. The Permittee shall: document the noncompliance or violation in the operating record, on the day the event occurred or the day it was discovered; notify the Executive Secretary of the Solid and Hazardous Waste Control Board within 24 hours, or the next business day following the event; and give written notice of the noncompliance or violation and measures taken to protect public health and the environment within seven days. Within thirty days of the occurrence of the event, the Permittee shall submit, to the Executive Secretary, a written report describing the nature and extent of the noncompliance or violation and the remedial measures taken or to be taken to protect human health and the environment and to eliminate the noncompliance or violation. Upon receipt and review of the assessment report, the Executive Secretary may order the Permittee to perform appropriate remedial measures including development of a site remediation plan for approval by the Executive Secretary.

2. It shall not constitute a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Compliance with the terms of this Permit does not constitute a defense to actions brought under any other local, State, or Federal laws. This permit does not exempt the Permittee form obtaining any other local, State or Federal permits or approvals.

4. The issuance of this Permit does not convey any property rights, other than the rights inherent in this permit, in either real or personal property, or any exclusive privileges nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations including zoning ordinances.

5. The provisions of this Permit are severable. If any provision of this Permit shall be held invalid for any reason, the remaining provisions shall remain in full force and effect. If the application of any provision of this Permit to

any circumstance is held invalid, its application to other circumstances shall not be affected.

F. Revocation

1. This Permit is subject to revocation if any condition of the permit is not being met. The Permittee will be notified in writing prior to any proposed revocation action and such action will be subject to all applicable hearing procedures established under UAC R315-12 and the *Utah Administrative Procedures Act.*

2. Revocation of this Permit does not revoke the financial assurance established for closure and post-closure care of the facility, nor remove any responsibility for completion of closure and post-closure care for the facility required in UAC R315-302-3.

II. DESIGN AND CONSTRUCTION

A. Design and Construction

1. The Permittee shall construct each landfill unit, run-on and run-off diversion systems, and the final cover, at closure, in accordance with the plans presented in the permit application and the Utah Solid Waste Permitting and Management Rules (UAC R315-301 thru 320). If ground water is encountered during excavation of the landfill, the Executive Secretary shall be notified immediately, and a contingency plan implemented or alternative construction design developed and submitted for approval.

2. The permittee shall notify the Executive Secretary of the completion of construction of any final cover system and shall receive approval of the construction by the Executive Secretary.

4. All engineering drawings submitted to the Executive Secretary must be stamped and approved by a professional engineer with a current registration in Utah.

B. Run-On Control

Drainage channels and diversions shall be constructed as specified in the permit application and maintained at all times to effectively prevent run-on from the surrounding area from entering the landfill.

C. Quality Assurance Construction Plan

1. A quality assurance plan for construction of the run-on/run-off diversion system and final landfill cover, at final closure, shall be submitted by the Permittee and approved by the Executive Secretary prior to construction of any part of the final cover at the landfill.

2. A qualified third party shall perform permeability testing on the final cover, and other testing as required by the approved Quality Assurance Plan. The results must be submitted as part of the as-built drawings to the Executive Secretary.

III. LANDFILL OPERATION

A. Plan of Operation

The Plan of Operation included in the permit application shall be kept on-site at the landfill. The landfill shall be operated in accordance with the Plan of Operation as included in the permit application. The Plan of Operation is to include hours of operation, incoming waste inspections, landfill inspection and monitoring schedule, description of equipment maintenance, procedures for controlling disease vectors, training and safety plans for site operators, and contingency plans in the event of fire or explosion. The Plan of Operation also is to include examples of forms used to record quantities of waste received, results of waste inspections, results of ground water and gas monitoring, and training programs completed.

B. Security

The Permittee shall operate the Landfill in a manner such that unauthorized entry to the facility is prevented. The front gate shall be locked during the time the landfill is not open. At least one person, employed by Millard County, shall be at the landfill during all hours that the landfill is open. Fencing and/or any other access controls as shown in the permit application shall be constructed to prevent access of persons or livestock by other routes.

C. Training

Permittee shall provide training for on-site personnel in landfill operation, including waste load inspection, hazardous waste identification, and personal safety and protection.

D. Burning of Waste

Intentional burning of solid waste is prohibited and is a violation of UAC R315-303-4(2)(b). All accidental fires shall be extinguished as soon as reasonably possible.

E. Daily Cover

The solid waste received at the landfill shall be completely covered at the end of each working day with a minimum of six inches of earthen material. At the end of each day of operation the amount of cover placed shall be recorded in the operating record and certified by the operator.

F. Ground Water Monitoring

This facility has demonstrated through geologic, hydrogeologic, climatic, and other factors that the landfill will not contaminate ground water and the ground water monitoring requirement has been waived in accordance with R315-308-1(3). The landfill shall be operated in a manner to meet the landfill standard for performance with respect to ground water as required by UAC R315-303-2(1). Any contamination of ground water resulting form operation of the landfill will result in the revocation of this waver.

G. Gas Monitoring

The Permittee shall monitor explosive gases at the landfill in accordance with the Gas Monitoring Plan contained in the permit application and shall otherwise meet the requirements of UAC R315-303-3(5).

If the concentrations of explosive gases at any of the facility structures, at the property boundary or beyond, ever exceed the standards set in UAC R315-303-2(2)(a), the Permittee shall immediately take all necessary steps to ensure protection of human health and notify the Executive Secretary. Within seven days of detection, place in the operating record the explosive gas levels detected and a description of the immediate steps taken to protect human health. Implementation of a remediation plan shall meet the requirements as stated in UAC R315-303-3(5)(b) and shall be submitted and approved by the Executive Secretary prior to implementation.

H. Waste Inspections

The Permittee shall visually inspect incoming waste loads to verify that no wastes other than those allowed by this permit are disposed in the landfill. A complete

waste inspection shall be conducted at a minimum frequency of 1 % of incoming loads, but no less than one complete inspection per week. Loads to be inspected are to be chosen on a random basis.

All containers capable of holding more than five gallons of liquid will be inspected to determine if the waste is acceptable for disposal.

All loads that the operator suspects may contain a waste not allowed for disposal at the landfill will be inspected.

Complete random inspections shall be conducted as follows:

1. The operator shall designate and mark the area to be used for complete inspections at the start of each operating day;

2. The load to be inspected will be chosen on a random basis;

3. Loads subjected to complete inspection shall be unloaded at the designated area;

4. Loads shall be spread by equipment or by hand tools;

5. A visual inspection of the waste shall be conducted by personnel trained in hazardous waste recognition and recognition of other unacceptable waste; and

6. The inspection shall be recorded on the waste inspection form found in the permit application. The form shall be placed in the operating record at the end of the operating day.

I. Disposal of Liquids

Disposal of containers of liquids larger than household size (five gallons), noncontainerized material containing free liquids, sludge containing free liquids, or any waste containing free liquids in containers larger than five gallons is prohibited.

J. Disposal of Special Wastes

Animal carcasses may be disposed at the bottom of the landfill working face and must be covered with other solid waste or earth by the end of the operating day they are received or they may be disposed in a special trench or pit prepared for

the acceptance of dead animals. If a special trench is used, animals placed in the trench shall be covered with six inches of earth by the end of each operating day.

Asbestos waste shall be handled and disposed in accordance with UAC-315-315-2.

If loads of incinerator ash are accepted for disposal it shall be transported in such a manner to prevent leakage or the release of fugitive dust. The ash shall be completely covered with a minimum of six inches of material, or use other methods or material, if necessary, to control fugitive dust. Ash may be used for daily cover when its use does not create human health and environmental hazard.

K. Self Inspections

The Permittee shall inspect the facility to prevent malfunctions and deterioration, operator errors, and discharges which may cause or lead to the release of wastes or contaminated materials to the environment or create a threat to human health. These general inspections shall be completed no less than quarterly and shall cover the following areas: Waste placement, compaction, and cover; fences and access controls; roads; run-on/run-off controls; final and intermediate cover; litter controls; and records. A record of the inspections shall be placed in the daily operating record on the day of the inspection. Areas needing correction, as noted on the inspection report, shall be corrected and the actions taken placed in the daily operating record.

L. Recordkeeping

The Permittee shall maintain and keep on file at the landfill, a daily operating record as required by UAC R315-302-2(3). The landfill operator shall sign the operating record at the end of each operating day. Each record to be kept shall be authenticated by the signature of the appropriate operator or personnel. The operating record shall include the following items:

1. A copy of the permit including the permit application;

2. The number of loads of waste and the weights or estimates of weights or volume of waste received each day of operation and recorded at the end of each operating day;

3. Major deviations from the approved Plan of Operation recorded at the end of the operating day the deviation occurred;

4. Results of other monitoring required by this permit recorded in the operating record on the day of the event or the day the information is received;

5. Records of employee training;

6. Records of all inspections conducted by the Permittee, results of the inspections, and corrective actions taken shall be recorded in the record on the day of the event;

7. Results of inspections conducted by representatives of the Utah Solid and Hazardous Waste Control Board and/or representatives of the Central Utah Public Health Department, when forwarded to the permittee;

8. Closure and Post-closure care plans; and

9. Results of landfill gas monitoring.

M. Reporting

On or before March 1 of each year, the Permittee shall prepare and submit, to the Executive Secretary, an Annual Report as required in UAC R315-302-2(4). The Annual Report shall include: the period covered by the report; the annual quantity of waste received; an annual update of the financial assurance mechanism, including a re-application for approval of the financial assurance mechanism; the results of gas monitoring; and all training programs completed.

N. Roads

All access roads, within the landfill boundary, used for transporting waste to the landfill for disposal shall be improved and maintained as necessary to assure safe and reliable all-weather access to the disposal area.

IV. CLOSURE REQUIREMENTS

A. Closure

Final cover of the landfill shall be as shown in the permit application. The final cover shall meet at a minimum the standard design for closure as specified in the UAC (R315-303-3(4)) plus sufficient cover soil or equivalent material to protect the low permeability layer from the effects of frost, desiccation, and root penetration. Until the final closure of the landfill, each filled landfill unit (trench)

shall be covered with a minimum of four feet of natural soil that has a permeability no greater than 1 x 10^{-5} cm/sec and shall be contoured to promote run-off and prevent ponding of storm waster on the closed units. A quality assurance plan for construction of the final landfill cover shall be submitted to, and receive approval from the Executive Secretary prior to construction of any part of the final cover at the landfill. A qualified third party shall perform permeability testing on the recompacted clay placed as part of the final cover. The Permittee shall also meet the requirements of UAC R315-302-2(6) by recording with the Millard County Recorder as part of the record of title that the property has been used as a landfill.

B. Post-Closure Care

The post-closure care at the closed landfill shall be done in accordance with the Post-Closure Care Plan contained in the permit application for a period of 30 years or until the Executive Secretary finds that the closed landfill has become stabilized and the conditions of UAC R315-302-3(7)(b) or (c) have been met.

C. Financial Assurance

1. The Permittee shall maintain a financial assurance mechanism that will cover closure and post-closure care costs which meets the requirements of UAC R315-309 as approved by the Executive Secretary. An annual revision of the closure costs, post-closure care costs, and the financial assurance mechanism shall be submitted to the Executive Secretary as part of the annual report. The financial assurance mechanism shall be adequately funded to provide for the cost of closure at any stage or phase or anytime during the life of the landfill, and must be fully funded within five years of the date waste is first received at the landfill.

V. ADMINISTRATIVE REQUIREMENTS

A. Permit Modification

Modifications to this permit may be made upon application by the Permittee or by the Executive Secretary. The Permittee will be given written notice of any permit modification initiated by the Executive Secretary.

B. Permit Transfer

This permit may be transferred to a new Permittee by meeting the requirements of the permit transfer provisions of UAC R315-310-10.

C. Expansion

1. This permit is for the operation of a Class I Landfill according to the design and Plan of Operation described and explained in the permit application. Any expansion of the current footprint designated in the description contained in the permit application will require submittal of plans and specifications to the Executive Secretary. The plans and specifications must be approved by the Executive Secretary prior to construction.

2. Any expansion of the landfill facility beyond the property boundaries designated in the description contained in the permit application will require submittal of a new permit application in accordance with the requirements of UAC R315-310.

D. Expiration

This permit shall expire five years from the effective date which is the date shown on the signature (first) page of this permit. Application for permit renewal shall be made at least 180 days prior to the expiration of this permit. If a timely renewal application is made and the permit renewal is not complete by the expiration date, this permit will continue in force until renewal is completed or denied.

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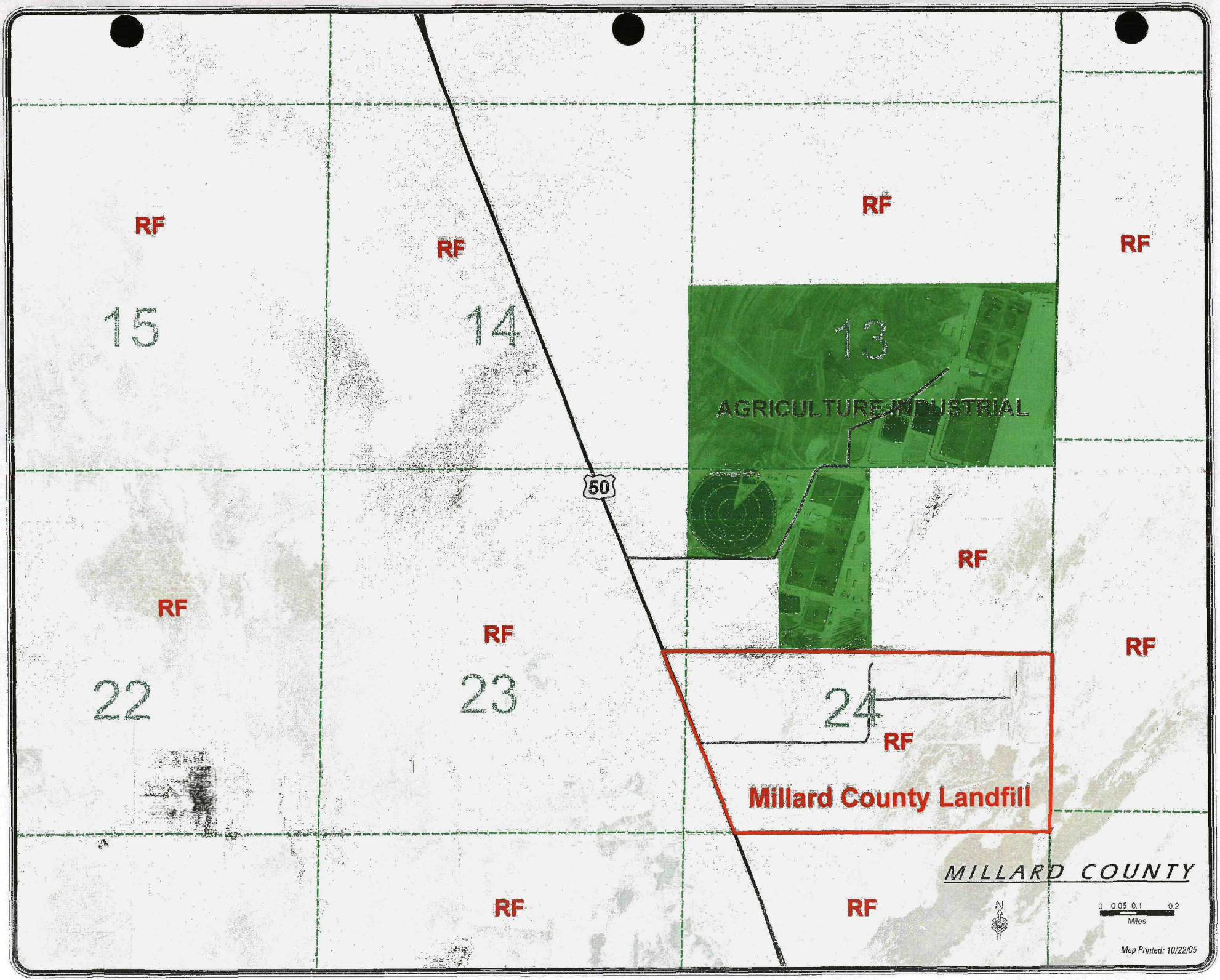
File: Millard County Landfill - Permit # 9431R1

APPENDIX B
Land Use Zoning Documents

MILLARD COUNTY 2001 LAND USE ZONING ORDINANCE (PROPOSED 8/8/01 draft)		Zone	RF	AG	AI	R 1	CC	HC	LI	HI	
use #	Description of Land Use										
4921	Freight Forwarding Services							P	C		
4922	Packing and Crating Services							P	C		
4923	Travel Arranging Services (including ticket services)						P	P			
4992	Approved, Protected Landfill, Hazardous Waste Disposal and Storage									C	
4993	Incinerator, Hazardous Waste Disposal									C	
4994	Hazardous Waste Processing Facilities									C	
Trade, Wholesale and Retail Land Use Code Number 5000		**Zone**	**RF**	**AG**	**AI**	**R 1**	**CC**	**HC**	**LI**	**HI**	
5100	Wholesale Trade (only as noted below)										
5110	Motor Vehicles and Automotive Equipment								C		
5120	Drugs, Chemicals and Allied Products								C		
5130	Dry Goods and Apparel								C		
5140	Groceries and Related Products (and as noted below)								C		
5142	Dairy Products and Wholesale Sales		A	A	A				C		
5143	Poultry Products and Wholesale Sales		A	A	A				C		
5146	Meat and Meat Products Wholesale Sales		A	A	A				C		
5147	Fruits and Vegetables Wholesale Sales		A	A	A				C		
5150	Farm Products Wholesale Sales		A	A	A				P		
5160	Electrical Goods (only as noted below)										
5161	Electrical Apparatus and Equipment Wholesale								P		
5170	Hardware, Plumbing, Heating Equipment and Supplies								P		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Map Printed: 10/22/05

MILLARD COUNTY PLANNING COMMISSION CERTIFICATION

Approved by Planning Commission: January 10, 1994
By: Leon Smith, Chairman

Person Making Application for Change: Millard County Planning and Zoning Commission / Jerry Reagan

ORDINANCE

An Ordinance amending the TEXT of the Millard County Zoning Ordinance.

The Board of County Commissioners of Millard County, State of Utah, Ordains as follows:

Change Land Use Code 4850: Add Land Use Code 4850, Solid Waste Disposal, as a permitted use in the RF-20 Zone subject to conditional use permit.

This Ordinance Change shall take effect upon passage.

PASSED AND ADOPTED by the Board of County Commissioners of Millard County, Utah, this 7 day of MAR, 1994.

Commissioner Baker Voting ✓ YES
Commissioner Moon Voting ✓
Commissioner Dearden Voting ✓

Signed: Lars S. Moon
Chairman, Board of County Commissioners

Attest: Geri Stephenson, Deputy
Millard County Clerk

DENIED OR REJECTED ON _____, 19____.

Signed _____
Chairman, Board of County Commissioners

White: County Commissioners Green: Assessor
Yellow: Applicant Pink: Clerk
Goldenrod: Retained by Planning Commission File # C-94-007

*Press Hard - Five Copies
pz-ord-amend

APPENDIX C
Landfill Property Deed

Form 1860-9
(January 1988)

The United States of America

To all to whom these presents shall come, Greeting:

U-68990

WHEREAS,

Millard County, Utah

is entitled to a land patent pursuant to Sections 203 and 209 of the Act of October 21, 1976 (43 U.S.C. 1713 and 1719, respectively), for the following described land:

Salt Lake Meridian, Utah

T. 17 S., R. 6 W.,
sec. 24, N½SE¼.

T. 22 S., R.19 W.,
sec. 5, Lot 5.

containing 101.13 acres

NOW KNOW YE, that there is, therefore, granted by the UNITED STATES, unto the above named claimant, the land described above; TO HAVE AND TO HOLD the said land with all the rights, privileges, immunities, and appurtenances, of whatsoever nature, thereunto belonging, unto the said claimant, its heirs and assigns, forever; and

EXCEPTING AND RESERVING TO THE UNITED STATES:

1. A right-of-way thereon for ditches or canals constructed by the authority of the United States. Act of August 30, 1890 (43 U.S.C. 945).

2. All of the oil, gas, and geothermal in the land located in T. 17 S., R. 6 W., sec. 24, N½SE¼, with the right to prospect for, mine, and remove the same under applicable law and such regulations as the Secretary may prescribe.

3. All of the oil and gas in the land located in T. 22 S., R. 19 W., sec. 5, Lot 5, with the right to prospect for, mine, and remove the same under applicable law and such regulations as the Secretary may prescribe.

Millard County, Utah, its successors or assigns, shall comply with all Federal and State laws applicable to the disposal, placement, or release of hazardous substances (substances as defined in 40 CFR 302).

Millard County, Utah, its successors or assigns, assumes all liability for and shall defend, indemnify, and save harmless the United States and its officers, agents, representatives, and employees (hereinafter referred to in this clause as the United States), from all claims, loss, damage, actions, causes of action, expense, and liability (hereinafter referred to in this clause as claims) resulting from, brought for, or on account of, any personal injury, threat of personal injury, or property damage received or sustained by any person or

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MILLARD COUNTY RECORDER - LINDA S CARTER
1995 SEP 25 11:15 AM FEE $.00 BY IMS
REQUEST: MILLARD COUNTY

Patent Number 43-95-0028

Form 1860-10
(April 1988)

U-68990

persons (including the patentee's employees) or property growing out of, occurring, or attributable directly or indirectly, to the disposal of solid waste on, or in the release of hazardous substances from T. 17 S., R. 6 W., Sec. 24, N½SE¼, or from T. 22 S., R. 19 W., Sec. 5, Lot 5, Salt Lake Meridian, Utah, regardless of whether such claims shall be attributable to: (1) the concurrent, contributory, or partial fault, failure, or negligence of the United States, or (2) the sole fault, failure, or negligence of the United States.

The above described lands have been utilized for landfill purposes and have been conveyed for utilization as landfill facilities. The land may contain small quantities of commercial and household hazardous waste as determined in the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901), and defined in 40 CFR 261.4 and 261.5.

IN TESTIMONY WHEREOF, the undersigned authorized officer of the Bureau of Land Management, in accordance with the provisions of the Act of June 17, 1948 (62 Stat. 476), has, in the name of the United States, caused these letters to be made Patent, and the Seal of the Bureau to be hereunto affixed.

GIVEN under my hand, in Salt Lake City, Utah
the Twenty-Third day of August
in the year of our Lord one thousand nine hundred and
Ninety-Five and of the Independence of the
United States the two hundred and Twentieth

By Teresa L Catt

Chief, Branch of Lands and Minerals Operations

Patent Number 43-95-0028

00102710 BK00290 PG00296

Form 2912-1
(January 1976)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Serial Number
U-51862

RECREATION OR PUBLIC PURPOSES LEASE

Act of June 14, 1926, as amended (43 U.S.C. 869 *et. seq.*)

This lease entered into on this 27 day of March, 19 84, by the United States of America, the lessor, through the authorized officer of the Bureau of Land Management, and

County of Millard
60 N. Main Street
Fillmore, UT 84631

, hereinafter called the lessee, pursuant and subject to the terms and provisions of the Recreation and Public Purposes Act and to all reasonable regulations of the Secretary of the Interior now or hereafter in force when not inconsistant with any express and specific provisions herein, which are made a part hereof,

WITNESSETH:

Sec. 1. The lessor, in consideration of the rents to be paid and the conditions to be observed as hereinafter set forth, does hereby grant and lease to the lessee the right and privilege of using for the purposes hereinafter set forth in the following-described lands:

T. 17 S., R. 6 W., SLM, Utah
Sec. 24, N½SE¼.

T. 22 S., R. 19 W., SLM, Utah
Sec. 5, N½N½NW¼.

containing 100 acres, together with the right to construct and maintain thereon all buildings or other improvements necessary for such use for a period of 25 years, the rental to be $ 10 per annum. If, at the expiration date of the lease the authorized officer shall determine that the lease may be renewed, the lessee herein will be accorded the privilege of renewal upon such terms as may be fixed by the lessor. The lessee may use the premises for

two Sanitary Landfill, waste disposal sites

Sec. 2. There are reserved to the United States all mineral deposits in said lands, together with the right to mine and remove the same under applicable laws and regulations to be established by the Secretary of the Interior.

Sec. 3. The lessor reserves the right of entry, or use, by

(a) any authorized person, upon the leased area and into the buildings constructed thereon for the purpose of inspection;

(b) Federal agents and game wardens upon the leased area on official business;

(c) the United States, its permittees and licensees, to mine and remove the mineral deposits referred to in Sec. 2, above.

Sec. 4. In consideration of the foregoing, the lessee hereby agrees:

(a) To improve and manage the leased area in accordance with the plan of development and management Filed on Aug. 25, 1982 or any modification thereof hereinafter approved by an authorized officer, and to maintain all improvements, during the term of this lease, in a reasonably good state of repair.

(b) To pay the lessor the annual rental above set forth in advance during the continuance of this lease.

(c) Not to allow the use of the lands for unlawful purposes or for any purpose not specified in this lease unless consented to under its terms; not to prohibit or restrict, directly or indirectly, or permit its agents, employees, contractors (including, without limitation, lessees, sublessees, and permittees), to prohibit or restrict the use of any part of the leased premises or any of the facilities thereon by any person because of such person's race, creed, color, sex, or national origin.

(d) Not to assign this lease or to change the use of the land, without first receiving the consent of the authorized officer of the Bureau of Land Management.

(e) That this lease may be terminated after due notice to the lessee upon a finding by the authorized officer that the lessee had failed to comply with the terms of the lease; or has failed to use the leased lands for the purposes specified in this lease for a period of 2 consecutive years; or that all or part of the lands is being devoted to some other use not consented to by the authorized officer; or that the lessee has not complied with his development and management plans referred to in subsection 4(a).

(f) That upon the termination of this lease by expiration, surrender, or cancellation thereof, the lessee, shall surrender possession of the premises to the United States in good condition and shall comply with such provisions and conditions respecting the removal of the improvements of and equipment on the property as may be made by an authorized officer.

(g) To take such reasonable steps as may be needed to protect the surface of the leased area and the natural resources and improvements thereon.

(h) Not to cut timber on the leased area without prior permission of, or in violation of the provisions and conditions made by an authorized officer.

(i) That nothing contained in this lease shall restrict the acquisition, granting, or use of permits or rights-of-way under existing laws by an authorized Federal officer.

Sec. 5. *Equal Opportunity Clause.* During the performance of this contract, the lessee agrees as follows:

(a) The lessee will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(b) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(c) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the lessee's commitments under Section 202 of Executive Order 11246 of September 24, 1965, as amended, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) The lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(e) The lessee will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, as amended, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(f) In the event of the lessee's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this permit may be cancelled, terminated or suspended in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, as amended, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of Sept. 24, 1965, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(g) The lessee will include the provisions of Paragraphs (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, as amended, so that such provisions will be binding upon each subcontractor or vendor. The lessee will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions including sanctions for noncompliance: *Provided, however,* That in the event the lessee becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

Sec. 6. The lessee may surrender this lease or any part thereof by filing a written relinquishment in the appropriate BLM office. The relinquishment shall be subject to the payment of all accrued rentals and to the continued obligation of the lessee to place the lands in condition for relinquishment in accordance with the applicable lease terms in subsections 4(f) and 4(g) and the appropriate regulations.

Sec. 7. The lessee further agrees to comply with and be bound by those additional terms and conditions identified as

Attachment "A" to R&PP Lease number U-51862

and which are made a part hereof.

Sec. 8. No Member of, or Delegate to, the Congress, or Resident Commissioner, after his election or appointment, and either before or after he has qualified, and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as otherwise provided in 43 CFR, Part 7, shall be admitted to any share or part of this lease, or derive any benefit that may arise therefrom, and the provisions of Title 18 U.S.C. Sections 431–433, relating to contracts, enter into and form a part of this lease, so far as the same may be applicable.

FOR EXECUTION BY LESSEE

IN WITNESS WHEREOF:

Michael R. Styles
(Signature of Lessee's Authorized Officer)

Madeline Wheeler
(Signature of Witness)

Feb 14 1984
(Date)

FOR EXECUTION BY THE UNITED STATES

THE UNITED STATES OF AMERICA

By Donald K. Hamilton
(Authorized Officer)

District Manager
(Title)

2/27/84
(Date)

GPO 838-097

ATTACHMENT "A"

Terms and Conditions

1. The lessee agrees to operate the disposal site in accordance with the Solid Waste Disposal Act (42 U.S.C. 3251), as amended by the Resource Conservation and Recovery Act of 1976, P.L. 94-580 (42 U.S.C. 6901), and the regulations contained in Part 241 of Title 40, Code of Federal Regulations (1976 edition and any regulatory amendments thereto). The operation of the disposal site will also follow the guidelines of the Utah State Division of Health, Code of Solid Waste Disposal Regulations. Failure to comply with the above referenced regulations shall constitute sufficient grounds for cancellation of the lease.

2. The leasee shall manage and improve the applied for land in accordance with the plan of development and operation submitted to the BLM on August 25, 1982 and sent to the State Division of Health.

3. All operations under this lease shall comply with applicable Federal, State, and local laws and regulations concerning the use of poisonous substances, including insecticides, pesticides, herbicides, fungicides, rodenticides, and other similar substances.

4. The lessee shall indemnify the United States against any liability for damage to life or property arising from the occupancy or use of BLM administered lands under the R&PP lease.

5. The County shall maintain the subject premises and improvements to standards of repair, orderliness, neatness, sanitation, and safety to meet all County, State and Federal laws, regulations, and ordinances applicalble to the area of operation.

6. Open burning shall not be permitted.

7. With this lease goes the legal right of access to the two landfill sites by the route designated in the plan of development and operation submitted by the lessee with his application and approved by the authorized officer.

The access roads from the sites to the existing legal roads shall be built within a right-of-way sixty six (66) feet wide. This shall include cut and fill slopes, borrow ditches, shoulders, and the road surface. The road shall be surfaced with rock where necessary to provide convenient access to the site year-round by the public. Where the road crosses natural drainages as well as anywhere along the course of the road, provisions shall be made to accommodate water flow without causing soil erosion or damage to the road.

8. At least 6 inches of earth shall be placed each operating

day over all waste material after compaction to the smallest practical volume. A minimum of 2 feet of earth shall be placed over any completed segment of the site. Final grading shall provide effective surface drainage.

9. Adequate fire protection shall be provided. This may include arrangements made with the nearest fire department to control any fires which may occur at the site.

10. Scavenging and salvaging shall be strictly prohibited unless specifically authorized by the County.

11. Appropriate rodent and insect control procedures shall be implemented as necessary.

12. Litter control along all access roads and aat the site shall be accomplished by cleanup of the areas as often as necessary to prevent unsightly conditions caused by blowing paper and other misplaced refuse.

13. Provisions for dust control at the site and along access roads shall be implemented as necessary.

14. Dead animals received at the site should be deposited onto the working face at or near the bottom of the cell with other solid wastes, or into a separate disposal area provided they are covered immediately with six inches of earth to prevent odors and the propagation and harborage of rodents and insects.

15. Runoff water shall be diverted from the sanitary landfill using diversion ditches, pipes, or any other acceptable means, if it is determined that such water might cause leachate contamination or other pollution problems. The BLM shall make this determination in concurrence with the EPA and Utah Division of Health.

16. The working face shall be limited to the smallest area practical to confine the amount of exposed waste without interfering with effective operation procedure.

17. Adequate equipment for trenching, compacting, and covering shall be available and in operating condition.

18. Development of the compactable waste trenches shall be done progressively, one at a time. Tall, close weave, net wire fencing shall be used around the active disposal areas to prevent rubbish from blowing from the site.

19. Vegetation should only be cleared as land is needed to develop the landfill. Vegetation should be left undisturbed where possible, by developing the landfill one step at a time, rather than clearing the entire acreage at the onset.

20. When the total acreage covered by this lease are fully

utilized for landfill purposes the land shall be smoothed and recontoured in such a way that it will blend with the surrounding area. The disturbed surface shall then be mulched with organic matter and seeded according to the specifications of the authorized officer.

21. The lessee shall be especially alert for archaeological, paleontological, or historical sites within the area granted under this lease. The Area Manager or his representative may require the lessee to relocate cells in order to avoid destruction of such sites. The Area Manager or his representative may also delay construction or maintenance operations until salvage of such sites has been completed. All costs of inventory and salvage operations on such sites within the lease will be borne by the lessee. All such salvage shall remain the property of the United States and will be turned over to the Bureau of Land Management.

DIRECT SALE
BLM/Millard County
Serial Number UTU-68990

NONBINDING STATEMENT OF INTENT

It is proposed that a direct sale of public lands be completed between the Bureau of Land Management (BLM) and Millard County. The public lands are located in Millard County and are described as follows:

PARCEL 1 - DELTA LANDFILL:

Salt Lake Meridian, Utah

T. 17 S., R. 6 W.
Sec. 24, N½SE¼ (80 Acres)
Sec. 24, N½SW¼, SW¼NW¼ (120 Acres)

T. 17 S., R. 5 W.
Sec. 19, Lots 1,2,3,4,5,6,7 and 8 (320 Acres)

Containing approximately 520 total acres.

PARCEL 2 - GARRISON LANDFILL:

Salt Lake Meridian, Utah

T. 22 S., R. 19 W.
Sec. 5, N½NW¼NW¼.

Containing approximately 20 acres.

Combined, the parcels include a total of approximately 540 acres.

Upon signature of both parties of this nonbinding statement, the following steps will be taken:

1. Millard County will submit an appropriate request for proposed direct FLPMA sale, including a statement regarding the purpose for the purchase of the existing landfill, and address the purpose and need/justification for obtaining additional lands.

2.* The BLM will prepare an environmental assessment of the proposed sale. This will take an estimated 45 days.

3.* If the decision, as a result of the environmental assessment and Director approval, is to proceed with the proposed land sale, **the BLM will** prepare an amendment to the House Range Resource Management Plan (HRRMP) and an amendment to the Warm Springs Resource Management Plan (WSRMP) to reflect the land transfer. This will take an estimated 75 days, which includes a 30 day publication and a 45 day comment period for following publication.

4. **The BLM** will prepare a mineral report concerning leasable and locatable minerals on the 540 acres requested for sale.

5. **The BLM** will obtain archaeological, threatened, endangered or sensitive plant and animal clearances for the 540 acres requested for sale.

6. **The BLM** will notify grazing permittees of the proposed public sale.

7. **Millard County** will obtain a <u>new</u> State permit (or a letter from the State indicating that the permit is forthcoming) to operate a landfill on the site and will submit a copy to this BLM office.

8. **Millard County and the BLM** will coordinate efforts to obtain a land transfer audit (LTA) and Record Review and Inspection Report from the State Department of Environmental Quality (DEQ) for the Garrison landfill site and for the additional adjacent and contiguous lands as described with the Delta landfill site in the proposed sale. LTA for the Delta and Garrison landfill sites should include signatures of the auditor and the lessee attesting that no significant risk to human health and the environment exist at the sites.

9. **The BLM** will obtain a signed indemnification statement **from Millard County.**

10.* **The BLM** will obtain a preliminary value estimate of the lands. This will take an estimated 30 days.

11. **The BLM** will determine if the proposed sale is in the public interest based on the land transfer audit, EA, Director review, and public comments received. If it is determined that the sale is in the public interest and will not result in adverse impacts to the human environment, the sale will continue to be processed. If it is determined that the sale is not in the public interest and that it may result in adverse impacts to the human environment, Millard County will be notified that the sale proposal has been denied.

12.* **The BLM** will secure a preliminary title opinion from the solicitor. This will take an estimated 45 days.

13.* **The BLM** will publish a Notice of Realty Action (NORA) in the Federal Register and local newspaper. This will take an estimated 60 days, including comment period.

14.* **The BLM** will obtain an appraisal from the Chief, State Appraiser to determine the fair market value. This will take an estimated 30 days.

15. **Millard County** will be responsible for payment of advertising and publication costs (Federal Register and newspaper notices).

16.* **The BLM** will obtain final title opinion from the solicitor. This will be done by the BLM and take an estimated 30 days.

17.* **The BLM** will issue a final decision on any protests received as a result of the proposed action. This will take an estimated 45 days.

18.* **The BLM** State Office will issue patent to the lands. This will take an estimated 30 days.

19.* **The BLM** will publish a notice of conveyance in the Federal Register. This will take an estimated 30 days.

* SOME TIME FRAMES NOTED MAY RUN CONCURRENTLY DURING THE RESPECTIVE PROCESSING STAGES OF THE PUBLIC SALE CASE FILE.

DISCLAIMER: The completion of this sale depends upon appropriated funds. Also, as this sale may not be completed, this statement of intent to complete the exchange does not legally bind either signing party.

It is each party's intent to enter into a binding land sale agreement at the time agreement is reached on the value.

4-5-93 4/8/93

Millard County Applicant — Date

Jerry Goodman District Manager — Date

INDEMNIFICATION STATEMENT

Millard County, its successors or assigns, assumes all liability for and shall defend, indemnify, and save harmless the United States and its officers, agents, representatives, and employees (hereinafter referred to in this clause as the United States), from all claims, loss, damage, actions, causes of action, expense, and liability (hereinafter referred to in this clause as claims) resulting from, brought for, or on account of, any personal injury, threat of personal injury, or property damage received or sustained by any person or persons (including the patentee's employees) or property growing out of, occurring, or attributable directly or indirectly, to the disposal of solid waste on, or in the release of hazardous substances from T. 17 S., R. 5 W., Sec. 19, Lots 1 through 8, and T. 17 S., R. 6 W., Sec. 24, N½SE¼, N½SW¼, SW¼NW¼, or from T. 22 S., R. 19 W., Sec. 5, N½NW¼NW¼, Salt Lake Meridian, Utah, regardless of whether such claims shall be attributable to: (1) the concurrent, contributory, or partial fault, failure, or negligence of the United Stats, or (2) the sole fault, failure, or negligence of the United States.

Dated the 5th day of April, 1993.

Commission Chair

Commissioner

Commissioner

MILLARD COUNTY LANDFILL
NOTIFICATION OF IN SERVICE TRAINING

Please Print

Employee's Name *(Last Name)* *(First Name)* *(Middle Initial)*

Employee Number *Social Security Number* *Class Completion Date*

Title of School or Training *Location* *Number of Hours*

Employee *Date*

I verify that this employee was present for the above listed training hours.

Training Officer, Instructor, or Supervisor *Date*

MILLARD COUNTY LANDFILL
NOTIFICATION OF IN SERVICE TRAINING

Please Print

Employee's Name *(Last Name)* *(First Name)* *(Middle Initial)*

Employee Number *Social Security Number* *Class Completion Date*

Title of School or Training *Location* *Number of Hours*

Employee *Date*

I verify that this employee was present for the above listed training hours.

Training Officer, Instructor, or Supervisor *Date*

MILLARD COUNTY LANDFILL
TRAINING ROLL

Date _____ **Location** _____

Subject _____ **Instructor** _____

Name	Department

APPENDIX D
Recordkeeping and Inspection Forms

MILLARD COUNTY LANDFILL
Daily Activity Log

DATE	TIME	INSPECTOR	DRIVER'S NAME	VEHICLE LICENSE	MAKE	MODEL	ESTIMATED WASTE VOLUME	FEE	OBSERVATIONS, DESCRIPTION OF REJECTED LOAD, REASON FOR REJECTION, VARIATIONS FROM OPS PLA

MILLARD COUNTY LANDFILL

RECORD OF RANDOM INSPECTION

DATE	TIME	INSPECTOR	LICENSE #	DRIVER'S NAME	MAKE/MODEL	ACCEPTED	UDEQ NOTIFIED?	UDEQ CONTACT

LOAD DESCRIPTION:

IF REJECTED, RATIONALE FOR REJECTION:

ACTIONS TAKEN:

MILLARD COUNTY LANDFILL

QUARTERLY/PERIODIC INSPECTION LOG

DATE	TIME	INSPECTOR	OBSERVATIONS	RECOMMENDED ACTIONS	DATE COMPLETE

MILLARD COUNTY LANDFILL

QUARTERLY GAS MONITORING LOG

DATE	TIME	INSPECTOR	LOCATION	%LEL	OBSERVATIONS	ACTION TAKEN IF %LEL > 25%

Mail to:
Dennis R. Downs, Director
Division of Solid and Hazardous Waste
P.O. Box 144880
Salt Lake City, Utah 84114-4880

Date Received:_____

SOLID WASTE FACILITY ANNUAL REPORT

Part I - General Information

Administrative Information Enter the information requested in the space provided below, including the name, title and telephone number of a contact person who can answer questions regarding this report.

Calendar or fiscal year of report: _____
If fiscal year, please provide period covered: From _____ To _____
Facility Name: _____
Mailing Address: _____
(Number & Street, Box and/or Route)
City:_____, State:_____ Zip Code:_____

Facility Location County: _____
T._____, R._____, Sec._____, _____¼ of _____¼
Lat._____° _____' _____"N, Long._____° _____' _____"W
Contact's Name:_____ Phone No.:(__)_____
Title:_____

Owner
Name:_____ Phone No.:(__)_____
Mailing Address:_____
(Number & Street, Box and/or Route)
City:_____, State:_____ Zip Code:_____

Operator
Name:_____ Phone No.:(__)_____
(if different from Owner above)
Mailing Address:_____
(Number & Street, Box and/or Route)
City:_____, State:_____ Zip Code:_____

Permit Information To insure complete records and proper filing please complete the following.

Permit No.:_____ Permit Date:_____
(If permit was issued after 1988) (date permit was signed)

Facility Type

Landfill*
[ ] Class I
[ ] Class II
[ ] Class IV
[ ] Class V

Other
[ ] Energy Recovery
[ ] Incinerator
[ ] Landtreatment

Mail to:
Dennis R. Downs, Director
Division of Solid and Hazardous Waste
P.O. Box 144880
Salt Lake City, Utah 84114-4880

Date Received:_____

SOLID WASTE FACILITY ANNUAL REPORT

Part I - General Information

Administrative Information. Enter the information requested in the space provided below, including the name, title and telephone number of a contact person who can answer questions regarding this report.

Calendar or fiscal year of report: _____

If fiscal year, please provide period covered: From _____ To _____

Facility Name: _____

Mailing Address: _____

(Number & Street, Box and/or Route)

City:_____, State:_____ Zip Code:_____

Facility Location County: _____

T._____, R._____, Sec._____, _____¼ of _____¼

Lat._____° _____' _____"N, Long._____° _____' _____"W

Contact's Name:_____ Phone No.:(___)_____

Title:_____

Owner

Name:_____ Phone No.:(___)_____

Mailing Address:_____

(Number & Street, Box and/or Route)

City:_____, State:_____ Zip Code:_____

Operator

Name:_____ Phone No.:(___)_____

(if different from Owner above)

Mailing Address:_____

(Number & Street, Box and/or Route)

City:_____, State:_____ Zip Code:_____

Permit Information. To insure complete records and proper filing please complete the following.

Permit No.:_____ Permit Date:_____

(If permit was issued after 1988) (date permit was signed)

Facility Type

Landfill

[ ] Class I
[ ] Class II
[ ] Class IV
[ ] Class V

Other

[ ] Energy Recovery
[ ] Incinerator
[ ] Landtreatment

Facility Status

[ ] Currently in Operation [ ] Closed - Date:_____
(Please provide date)

[ ] Facility will close before
April 9, 1994 - closure date:_____
(Please provide expected closure date)

[ ] Facility will close before
October 9, 1995 - closure date:_____
(Please provide expected closure date)

Part II - Other Information

Annual quantity, in tons or volume, of solid waste disposed at the facility. If the data is available, the quantity of solid waste disposed in each category should also be listed (residential, commercial, and industrial).

Landfills are also to report the estimated in-place density in pounds per cubic yard of the disposed solid waste.

An annual update of the financial assurance for closure and post-closure care of the facility to adjust for inflation or facility modification that may affect costs of closure or post-closure care.

Copies of the results of all ground water monitoring activities completed during the year.

Copies of the results of all landfill gas monitoring activities completed during the year.

A report of all training programs or procedures completed by facility personnel during the year.

MILLARD COUNTY
ACCIDENT / INJURY REPORT

Report #

INJURED

Person involved or injured:_____ Date of accident or injury:_____
Address:_____ City:_____ State:_____ Zip:_____
Home Phone #:_____ S.S. #:_____ Date of Birth:_____
Sex: Male / Female Marital Status: Married / Single No. of dependents:_____
Number of days worked per week:_____ Number of hours worked per day:_____
Employing Department:_____ Job title:_____

OCCURRENCE

Time person began work:_____AM / PM Time of occurrence:_____AM / PM
Last work date:_____ Date returned to work:_____
Date supervisor notified:_____ If fatal, date of death:_____
Type of injury/illness:_____ Part of body affected:_____
General work procedure or activity person was involved in:_____
Specific activity:_____
Explain in detail the sequence of events that led to this incident:_____
_____
The occurrence was a result of: Human Error Equipment Failure Other (specify)_____
All equipment, materials, etc the person was using at the time of the incident:_____
_____
Was occurrence on county premises: Y / N Location of occurrence:_____
Were safeguards provided? Y / N Were they used? Y / N
Witnesses (name and phone number):_____

TREATMENT

Initial Treatment

0___	No Medical Treatment
1___	Minor, by Employer
2___	Minor Clinic/Hospital
3___	Emergency Care
4___	Hospitalized >24 Hours
5___	Future Major Medical/ Lost Time Anticipated

Physician:_____
Address:_____
City:_____
State:_____ Zip:_____
Phone #:_____
Hospital:_____
Address:_____
City:_____
State:_____ Zip:_____
Phone#:_____

What action could have been taken to prevent this incident?_____
_____
What action could be taken to prevent a reoccurrence?_____
_____

Signature of person:_____ Signature of Supervisor:_____
Date:_____ Date:_____

Please return this completed form to the Millard County Auditor's Office

Do not write below this line

REVIEWED BOARD

Signature of Review Board Member:_____
Date:_____

APPENDIX E
Application for a Waiver from Ground Water Monitoring and Liner Requirements at the Millard County Landfill
Submitted to UDEQ November, 1994

APPLICATION FOR A WAIVER FROM GROUND WATER MONITORING AND LINER REQUIREMENTS AT THE MILLARD COUNTY LANDFILL

Prepared for:

Millard County
71 S. 200 W., Box 854
Delta, Utah 84624
(801) 864-2788

Prepared by:

VECTOR ENGINEERING, INC.
1601 Fairview Avenue, Suite H
Carson City, Nevada 89701
(702) 883-7065

Job No. 94-5013.00 Ph. 5
November, 1994

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EXECUTIVE SUMMARY

The Millard County Landfill is located approximately four miles east-southeast of the City of Delta in Millard County, Utah, and serves the residents of Delta and outlying areas of Millard County. The landfill is an existing Class I facility which must be in regulatory compliance with the Utah Solid Waste Regulations (Utah Administrative Code R315-301-320) prior to February 1, 1995. Based on the information presented in this document, Millard County requests that a waiver be granted by the Utah Department of Environmental Quality (UDEQ) which will allow continued operation of the site without installation of a ground water monitoring or liner system, as provided by Sections R315-308-1(3) and R315-303-4(3)(c) of the Utah Administrative Code.

This document constitutes an application for a waiver from ground water monitoring and liner requirements at the Millard County Landfill, and consists of a technical justification in support of approval of such a waiver. In the development of this application, a site-specific study of the hydrogeologic setting of the Millard County Landfill was performed, and the volume of leachate potentially generated over the life of the facility was modelled using the HELP II - Version 2.05 software program. The WHPA computer program was used to approximate the potential magnitude of the influence of ground water contamination resulting from leachate potentially generated at the landfill. Results of these investigations indicate that operation of the Millard County Landfill is unlikely to cause degradation of waters of the state, or to endanger human health or the environment. The supporting data presented in this report can be separated into four overlapping areas of concern: hydrogeologic setting, design and operational elements, HELP II modelling of the leachate generation potential at the site, and WHPA modelling of ground water movement beneath the landfill.

The data submitted in this report supports the operation of the Millard County Landfill without a ground water monitoring or liner system. Millard County is therefore requesting approval of a waiver to operate the Millard County Landfill without installation of a ground water monitoring or liner system, as per Sections R315-308-1(3) and R315-303-4(3)(c) of the Utah Administrative Code.

SIGNATURE PAGE

I certify as a qualified ground water scientist, as defined under Utah Administrative Code R315-301-2(57), that the following application for a waiver from ground water monitoring requirements was prepared in accordance with generally accepted hydrogeological practices applicable at the time the report was prepared. Vector Engineering, Inc., makes no other warranties, expressed or implied, as to the professional advice provided in this report. Recommendations contained in this report are based on review of existing regulations, published literature, and field investigations of the site. The following technical justification was prepared in accordance with the requirements of the Utah Administrative Code, Utah Solid Waste Permitting and Management Rules R315-301 through 320.

VECTOR ENGINEERING, INC.

Donna Keats
Senior Geologist

Approved:

Charles R. Kuhn
Executive Vice President

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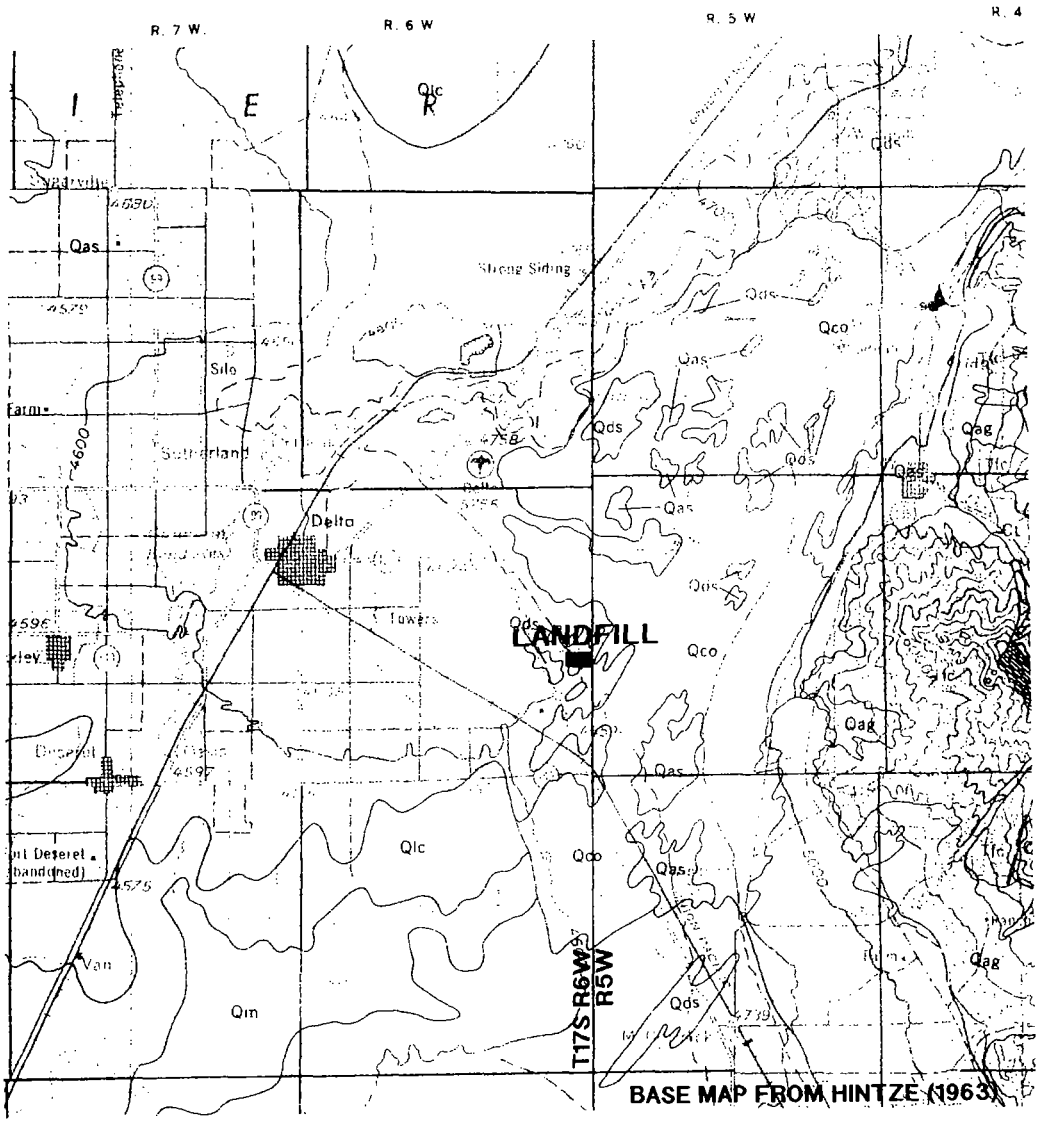
1.0 INTRODUCTION

The Millard County Landfill is located on a broad alluvial plain west of the Canyon Mountains, approximately four miles east-southeast of the City of Delta in Millard County, Utah. As described by the Public Land Survey system and illustrated in Figure 1, it occupies the N½ of the SE¼ of Section 24, T. 17 S., R. 6 W., Salt Lake Meridian (SLM). The site is an existing landfill which accepts approximately 20 to 25 tons of waste per day, and is therefore considered a Class I facility as defined by the Utah Solid Waste Permitting and Management Rules (UAC R513-301-2). This site was originally required to be in regulatory compliance with the Utah Solid Waste Permitting and Management Rule prior to November 1, 1994. However, negotiations with the Utah Department of Environmental Quality have resulted in an extension of the compliance deadline to February 1, 1995. Millard County wishes to resolve issues concerning ground water monitoring and liner requirements in advance of this deadline, in order to develop the appropriate operating, monitoring, design, closure, and post-closure plans for submission with the application for a permit to operate the site.

Millard County retained Vector Engineering, Inc. (Vector), to examine the hydrogeological conditions at the Millard County Landfill, and to develop an application for operation of the site without installation of a ground water monitoring or liner system. It should be noted that a technical justification for the exclusion of a ground water monitoring system addresses the same issues which are critical to obtaining approval for operation without a liner system. Therefore, this application for a waiver from ground water monitoring requirements will also serve as a technical justification for operation of the site without a liner system.

2.0 LEGAL BASIS

The basis of obtaining a waiver from ground water monitoring criteria can be found in the provisions of the State of Utah, Department of Environmental Quality Solid Waste Permitting and Management Rules, R315-301 through 320. Utah Administrative Code (UAC) Section R315-308 states that the requirements for ground water monitoring as set forth in UAC Section R315-308-2, "may be suspended by the Executive Secretary if the owner or operator of a solid waste disposal facility can demonstrate that there is no potential for migration of hazardous constituents from the facility to the ground water during the active life of the facility and the post-closure care period." According to UAC Section R315-308-1(3)(a,b), the demonstration must be based on measurements collected at specific field sites and the sampling and analysis of physical, chemical, and biological processes affecting the fate and transportation of contaminants; and, predictions of the fate and transportation of contaminants which are based on the maximum possible



N

SCALE: 1:250,000

Qas	*Alluvial surfaces; mostly sloping and well drained with soil profile suitable for crops. Mostly not stony.*
Qco	*Miscellaneous covering deposits; including wind blown material, thin soil, and alluvium.*
Qag	*Colluvium and alluvium; mostly stony and unfit for agricultural crops.*
Qds Qdg	*Dunes:* Qds, *siliceous;* Qdg, *gypsiferous.*
Qlc	*Lake bed sediments, mostly dry clay or dust, poorly drained and with enough salt to prohibit agriculture.*
Qm	*Marshland, mostly freshwater but some salty or brackish.*

VECTOR ENGINEERING, INC

Carson City, NV • Grass Valley, CA • El Dorado Hills, CA

JOB NO. 94-5013.00 Ph. 5.0 DATE: 11/3/94

MILLARD COUNTY LANDFILL

Site Vicinity and Geology Map

FIGURE 1

distance of the migration of contaminants and a consideration of the impacts on public health and safety and the environment.

Similarly, the basis of a technical justification for operation of a landfill without a liner system lies in the provisions of Section R315-303-4 of the UAC, which states that an owner or operator may use, as approved by the Executive Secretary, alternative design, operating practices, and location characteristics which will minimize the migration of solid waste constituents or leachate into the surface or ground water, and which are at least as effective as the liners of Subsections R315-303-4(3)(a) or (b). The owner or operator must also demonstrate that the standard of Subsection R315-303-3(1), which states that an owner or operator shall not contaminate the ground water underlying a facility, can be met. Additionally, the demonstration must be approved by the Executive Secretary, and must be based upon the hydrogeologic setting of the facility and surrounding land, the climatic characteristics of the area, the volume and physical and chemical characteristics of the anticipated leachate, and prediction of contaminant fate and transport in the subsurface that maximize contaminant migration and consider impacts on human health and the environment.

As required by both Sections R315-303-4 and R315-308-1, this technical justification for a waiver from ground water monitoring and liner requirements demonstrates that, based on site-specific physical and operational characteristics, operation of this site is consistent with the protection of public health and the environment, and the protection of waters of the state from degradation by pollutants or contaminants. It shows that the Millard County Landfill is unlikely to produce a significant amount of leachate or pollute or degrade waters of the state, and therefore will not require monitoring of ground water or the installation of a liner system.

3.0 SCOPE OF INVESTIGATION

This report presents a technical justification for approval of a waiver from ground water monitoring and liner requirements at the Millard County Landfill. A sound technical justification for such a waiver must utilize site-specific data, such as the geologic and structural setting, climate, hydrologic environment, and design and operational controls, to demonstrate that substantial quantities of leachate will not be generated. It must also show that, if leachate is generated, it will not adversely impact ground water and will therefore not endanger human health or the environment.

The most important factor affecting leachate generation and migration at the Millard County Landfill is the availability of water, which is dependent upon the climatic and hydrogeologic setting and the design and operation of the site. Therefore, initial

investigations for this project focused on a literature review of published and unpublished data on the regional and local climatic, hydrologic, and geologic setting of the area. After quantifying the available information, hollow-stem augering and air rotary drilling were employed in order to evaluate both the surface and subsurface characteristics of the site. Based on these site-specific data, the potential for leachate to be generated at the landfill was modelled using Version 2.05 of the HELP II software program (Schroeder et.al., 1989). Additional modelling was performed using the WHPA computer program to obtain an estimate of the magnitude of influence of potential contamination from the landfill on ground water beneath the site. Results of these investigations are presented in subsequent sections of this report.

4.0 CLIMATE

The climate in the general vicinity of the landfill ranges from semiarid in the lower portions of the basin to subhumid at higher elevations in the nearby mountains. Average annual precipitation ranges from six inches on the basin floor to more than 25 inches in the Canyon Mountains east of the site (Holmes, 1984). Most of the precipitation received in the area occurs during the months from March through May, mainly in the form of high-intensity thunderstorms. Monthly average temperatures in the Delta area range from 26.0 °F in January to 75.7 °F in July. Maximum temperatures may exceed 105 °F in the summer, while minimum temperatures may be less than 0°F in the winter months (Brough, et.al., 1987). Evaporation rates in the area are far in excess of precipitation and were estimated by Mower and Feltis (1968) and Holmes (1984) at approximately 60 inches per year from open bodies of fresh water.

5.0 GENERAL GEOLOGIC SETTING

The Millard County Landfill is located on a broad alluvial plain in the Sevier Desert region of southwestern Utah. The Sevier Desert is bordered on the east by the Canyon Mountains and the Pavant Range, on the west by the House Range, on the south by the Cricket Range, and on the north by the Tintic and Simpson Mountains. Published geologic mapping of the area which encompasses the Millard County Landfill is limited in detail. A map of southwestern Utah by Hintze (1963) at a scale of 1:250,000 provides geologic coverage of the landfill site. As abstracted from Hintze's (1963) map, the landfill area is dominated by Quaternary alluvial and eolian sediments. The basin area which includes the landfill is underlain by deposits of semi-consolidated to unconsolidated sediments of Tertiary and Quaternary age (Figure 1). The mountains east of the landfill are composed of various consolidated sedimentary, igneous, and metamorphic rocks (Mower and Feltis, 1968). Oviatt (1989) mapped the area immediately west of the landfill and identified three sedimentary units which are likely to extend into the vicinity

of the landfill. These units consist of fine-grained alluvial, deltaic, and lacustrine deposits which are associated with the floodplain of the Sevier River and Pleistocene Lake Bonneville.

6.0 GENERAL HYDROLOGIC SETTING

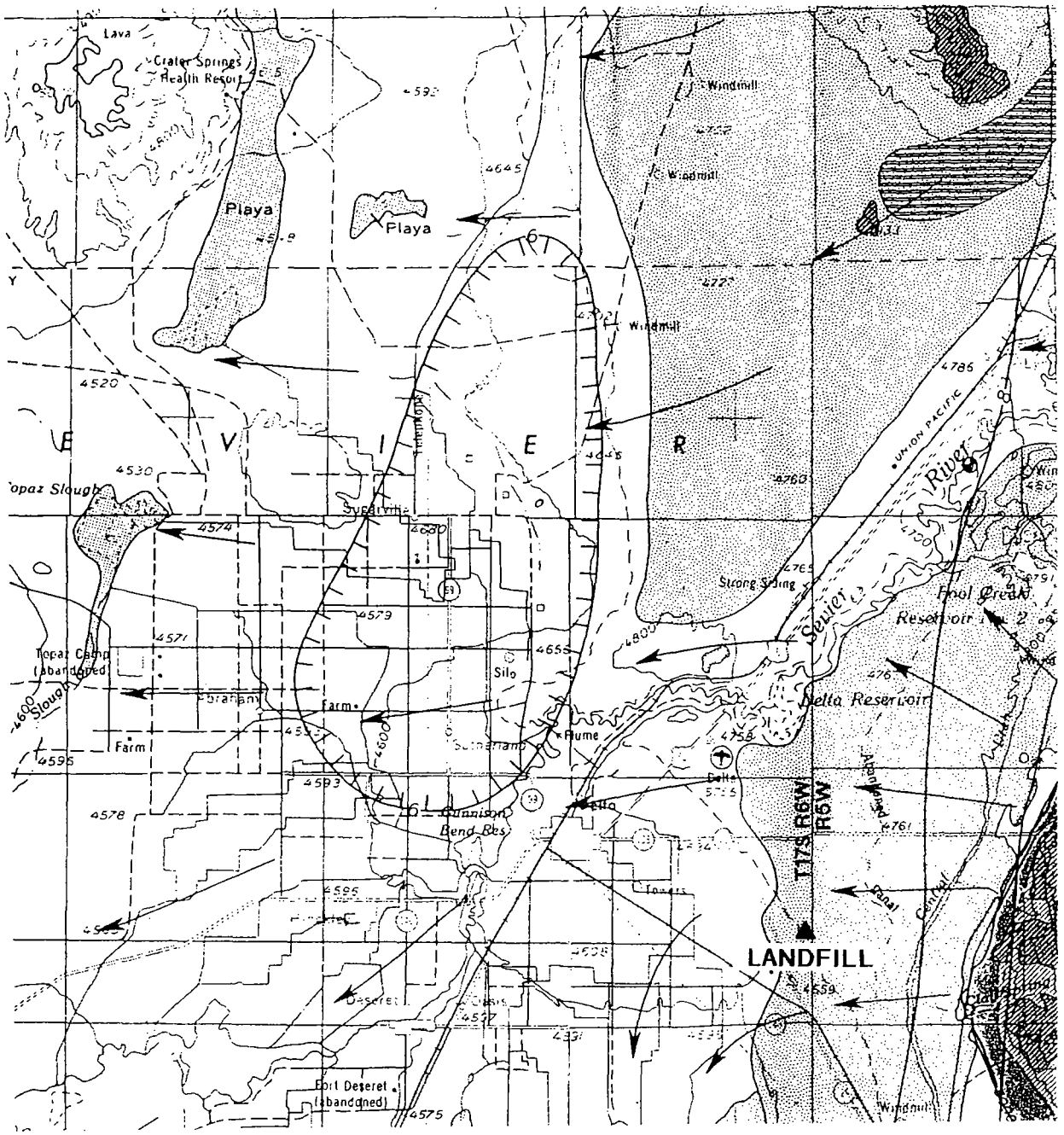
The main ground water reservoir in the vicinity of the landfill is comprised of unconsolidated basin fill deposits, which consist dominantly of clay, silt, sand, and gravel. At its thickest point, the basin fill is at least 1300 feet thick, and may be as thick as 2140 feet (Mower and Feltis, 1968). The ground water reservoir within the basin was divided into three aquifers by Mower and Feltis (1968): a shallow water table aquifer, and an upper and lower artesian aquifer. Fine-grained deltaic and lacustrine sediments form the confining zones between the aquifers. The ground water reservoir is recharged by direct penetration of precipitation through coarse, unconsolidated sediments, seepage from streams and canals, by underflow from adjacent basins, and by flow through fractured rock along the basin margins.

6.1 Occurrence and Depth of Ground Water

During a preliminary investigation of the occurrence and depth of ground water in the vicinity of the Millard County Landfill, published hydrogeologic information was reviewed. Ground water reports by Mower and Feltis (1964), Hecker, et.al. (1988), Enright and Holmes (1982), and Holmes (1984) record well data for the Delta, Utah area. However, the closest well to the landfill which has recorded information and is in a similar topographic location is approximately two miles directly north of the landfill. Data from 1960 through 1982 for this well, collared at an elevation 4726 feet (MSL), indicate water levels at approximately 80 feet below the ground surface, or an elevation of 4646 feet (Enright and Holmes, 1982). Regional ground water data are recorded in reports by Thomas, et.al. (1986) and Mower and Feltis (1968). These reports place the elevation of the potentiometric surface at 4650 and 4630 feet mean sea level (MSL), respectively. The surface of the landfill property varies in elevation from 4685 to 4710 feet MSL. Initial estimates of the depth to ground water based on this information are therefore from 35 to 80 feet below the ground surface.

6.2 Direction of Ground Water Flow

According to Harrill et.al. (1988) and Mower and Feltis (1968), regional groundwater flow in the eastern part of the Sevier Desert is from the Canyon Mountains west toward the Sevier River, and then southwest following the course of the river, as illustrated in Figure 2. Available data from research and site investigations are of



FLOW DIRECTION

N

SCALE: 1:250,000

BASE MAP FROM MOWER AND FELTIS (1968)

VECTOR ENGINEERING, INC Carson City, NV • Grass Valley, CA • El Dorado Hills, CA JOB NO. 94-5013.00 Ph. 5.0 DATE: 11/3/94	MILLARD COUNTY LANDFILL Ground Water Flow Direction Map	FIGURE 2

insufficient detail to more accurately determine the direction of ground water flow near the landfill.

7.0 FIELD INVESTIGATION

Subsurface exploration was employed to characterize the hydrogeologic setting, test the vertical and lateral continuity of the units, establish the depth to ground water, and determine the character of the uppermost aquifer. In order to present a comprehensive and defensible waiver application in light of the fairly shallow projected depth to ground water, it was critical to determine the actual depth to ground water, and the permeability and lateral continuity of the underlying sedimentary layers.

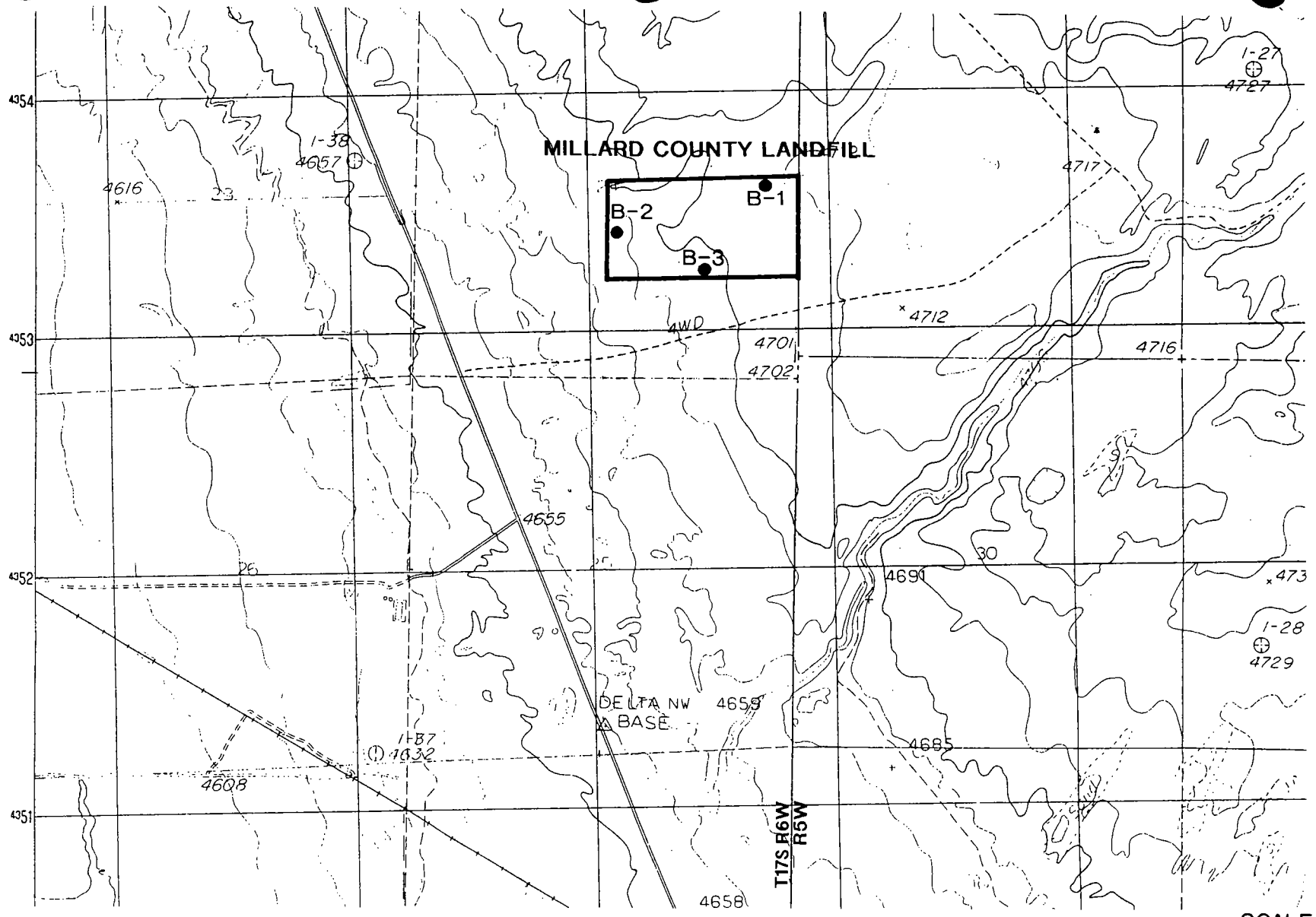
7.1 Subsurface Exploration

Three vertical holes were drilled at the site from August 23-25, 1994, by Mountain States Drilling of Salt Lake City, Utah. Hollow-stem augering and air rotary drilling methods were employed. Drill holes B-2, B-3, and B-1 were collared at approximate elevations of 4685, 4697, and 4708 feet (MSL), and reached total depths of 82.5', 97.5' and 77', respectively. The corresponding subsurface elevations reached in each hole were 4602.5, 4599.5, and 4631 feet (MSL). All holes were logged in the field and samples were field-classified according to the Unified Soil Classification System.

All holes were drilled with air injection only, in order to assess soil moisture and the occurrence of ground water throughout the depth explored. Drill hole locations are shown on Figure 3. Relatively undisturbed soil samples were collected using a Modified California split spoon sampler driven by a 140 pound hammer dropped over a thirty-inch interval. Drilling confirmed the presence of laterally continuous, relatively thick layers of silt, clay, and sand. In general, the upper 20 to 30 feet of each hole were logged as clayey silt, underlain by 30 to 40 feet of interbedded silts and clays, and then fine-grained silty sand to the depths explored. Subsequent laboratory analyses indicate that some of the clayey silt encountered in the top 20 to 30 feet of each hole is laboratory-classified as a low-plasticity, lean clay. Detailed drill logs for all holes are contained in Appendix A.

7.2 Analytical Data

Laboratory tests were performed on three samples collected during the site investigation. Laboratory testing included sieve analyses, Atterberg limits, and flexible-wall permeability tests. Permeability tests on two silty clay samples and one clayey silt sample indicated permeabilities of $1x10^{-8}$, $5x10^{-8}$, and $6x10^{-9}$ cm/sec, respectively. The first



SCALE: 1" = 2000'

CONTOUR INTERVAL = 10'
BASE MAP FROM USGS HARDING QUADRANGLE (1985)

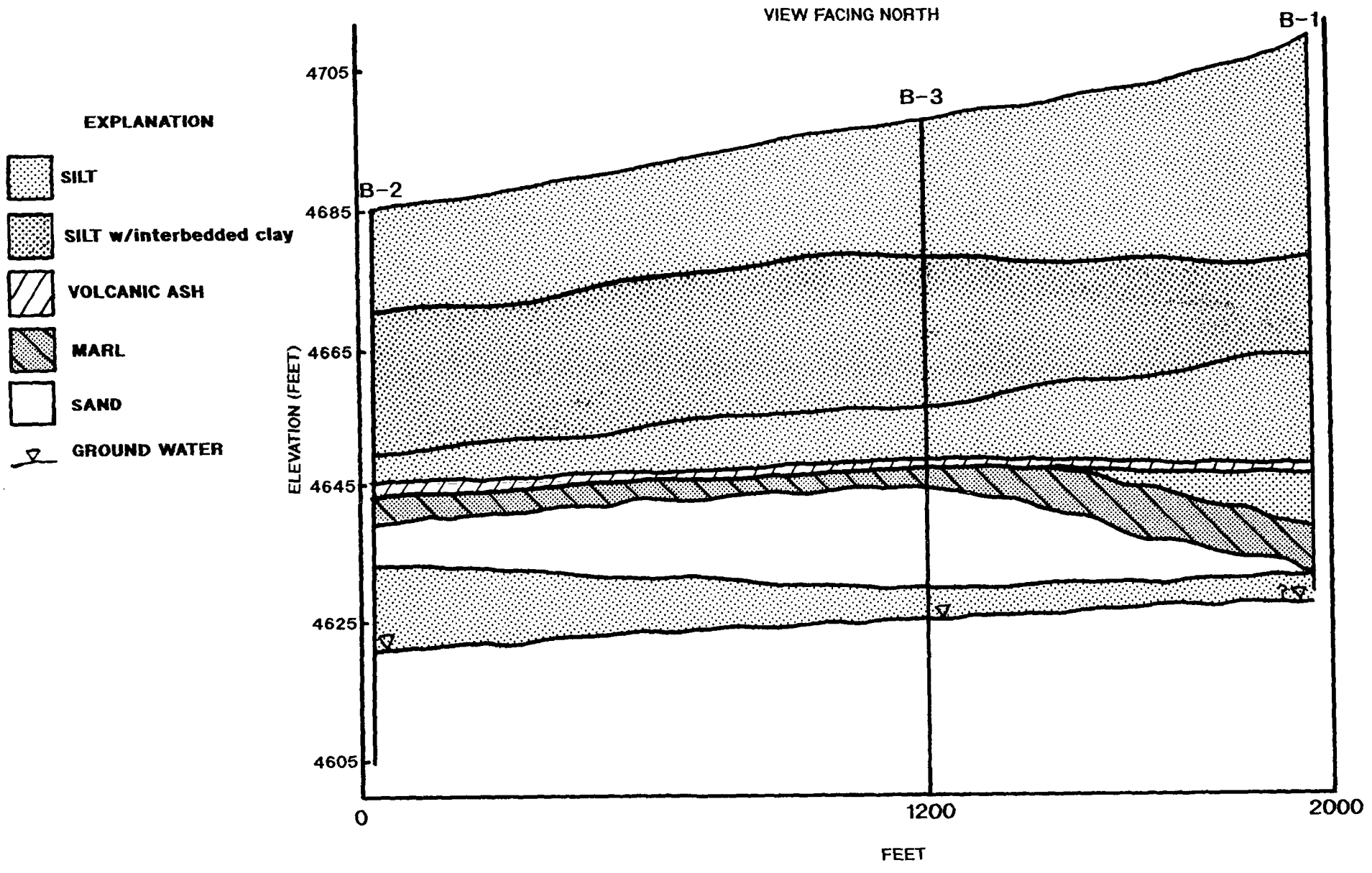
VECTOR ENGINEERING, INC Grass Valley, CA • El Dorado Hills, CA • Carson City, NV JOB NO. 94-5013.00 Ph. 5.0 DATE: 11/3/94	MILLARD COUNTY LANDFILL DRILL HOLE LOCATION MAP	FIGURE 3

permeability sample was taken from hole B-1 at a depth of 53 feet. The layer sampled was field classified as a sandy silt with clay interbeds, and had a total thickness of approximately 25 feet. The second permeability sample was taken from hole B-2 at 43 feet. The sample was laboratory classified as a fat clay and represents a two to three foot layer. The third permeability sample was taken in hole B-1 at 32.5 feet. This sample was field-classified as a sandy silt with clay interbeds and represents a layer approximately 4 feet thick. Numerous layers were encountered which were field classified as similar to one of the described units. These laboratory-derived data are considered to be representative of site conditions immediately beneath the fill area and were subsequently used in assessing the potential for generation and migration of leachate at the landfill (Section 9.0 of this report). It should be noted that the total thickness of the low permeability layers described above is in excess of the alternative liner requirements as defined in UAC Section R315-30304(3)(b).

7.3 Geologic Interpretation

The general geologic setting of the Millard County Landfill has been refined based on the results of the literature research and subsurface exploration. Drill logs reflect the presence of a layer of light grey clay at each of the locations drilled. This light grey clay is assumed to be the unit described by Oviatt (1989) as a white marl (Qlm), and described as fine-grained white to grey authigenic sediments deposited by Lake Bonneville. At the locality described by Oviatt (1989), approximately 6.5 miles north of the landfill, the marl is reportedly overlain by 66 feet of finely bedded silt and fine sand associated with underflow-fan deltaic deposits of the Sevier River. This description corresponds well with the thick sequences of silt encountered near the top of each drill hole. A thin layer of black, volcanic sand-sized ash was encountered within, or just above, the light grey clay at each of the locations. The black volcanic ash is correlated to the Pavant Butte basaltic ash (Qva), which is exposed at the surface approximately 10 miles south of the landfill near Pavant Butte. The ash is reportedly derived from an eruption at Pavant Butte which occurred approximately 15,500 years before present.

A schematic geologic cross section constructed from data obtained during the subsurface investigation is presented in Figure 4. The line of section runs roughly west to east across the entire 80-acre landfill property. The available evidence, derived from the drill logs and a review of available literature, suggests that the beds of sand, silt, and clay are laterally continuous on the scale of the landfill property. Based on the description and occurrence of the white marl described by Oviatt (1989), this unit could be laterally correlated over distances of 6 miles or more. The low-permeability, laterally continuous layers beneath the landfill will act as a natural barrier to vertical flow in the subsurface.



HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 20'

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MILLARD COUNTY LANDFILL

Schematic Geologic Cross Section

FIGURE 4

7.4 Hydrologic Interpretation

Ground water was encountered in two of the three holes drilled at the landfill. In drill hole B-1, a producing zone of water was not encountered. Drilling in this hole was terminated when a "sticky" layer encountered at a depth of 77 feet plugged the drill bit. Adequate air pressure could not be maintained using the equipment on hand. As a result, B-1 was abandoned prior to a determination of the elevation of the ground water table. The hole was allowed to sit over night. By morning, the hole had caved to 71 feet and water had risen in the hole to a depth of 69 feet, or 4630 feet (MSL). It is postulated that the "sticky" layer encountered was actually the top of the water-bearing zone. A water-bearing zone was encountered in holes B-2 and B-3 at elevations of 4622 and 4626 feet (MSL), or depths of 63 and 71 feet, respectively. In both holes, water was found in a fine silty sand, immediately beneath a clayey, sandy silt. Water levels rose to elevations of 4630 and 4633 feet (MSL) in drill holes B-2 and B-3, respectively. This corresponds to pressure heads of 8 and 7 feet in holes B-2 and B-3, and indicates that the water is confined beneath a relatively impermeable layer of clayey, sandy silt. Laboratory permeability analyses of a similar clayey silt from 32.5 feet in B-1 indicated a permeability of 5.2×10^{-9} cm/sec.

The silty sand water-bearing zone extended from depths of 64 feet to greater than 82.5 feet in hole B-2, and from 72 to 97.5 feet in hole B-3. The bottom of the water-bearing zone was not encountered in hole B-2, and is assumed to be at 97.5 feet in hole B-3, where a sticky layer of clayey silt was encountered. While drilling through the silty sand, water was produced in amounts which increased with increasing layer thickness. Maximum water production was measured at approximately five gallons per minute.

7.5 Conclusions

Based on the data and interpretations developed from a site-specific field investigation and presented in the preceding sections, the following conclusions have been reached:

- the lithologic section beneath the Millard County Landfill was shown to contain numerous layers of relatively impermeable silty clay and clayey silt;
- subsurface layers are laterally continuous on the scale of the landfill property;
- a water-bearing zone exists beneath the site at depths ranging from 63 to 71 feet, or from 38 to 46 feet below the base of existing and future disposal trenches;
- ground water beneath the site exists under confined conditions with an average pressure head of 7.5 feet;

- laboratory analyses on the clay and silt layers which underlie the base of the fills yielded permeabilities of $1x10^{-8}$ and $5x10^{-8}$ cm/sec for silty clay, and $6x10^{-9}$ cm/sec for clayey silt/lean clay; and,
- the large thickness and low permeability of the underlying sediments exceed the alternative bottom liner requirements (UAC Section R315-303-4(3)(b)) of three feet of compacted soil having a permeability less than or equal to $1x10^{-7}$ cm/sec, and therefore act as an *in-situ* liner system.

Each of these conclusions supports the contention that the hydrogeologic conditions underlying the Millard County Landfill are protective of ground water quality, and that operation of the site without a liner or ground water monitoring system is unlikely to cause degradation of surface or ground water.

8.0 LANDFILL DESIGN AND OPERATION

As mentioned above, the availability of water is perhaps the single most important factor affecting the volume of leachate generated at a landfill facility. There are several important elements of landfill design and operation which will reduce or prevent leachate production at the Millard County Landfill. These include trench configuration and active life, surface water controls, liquid waste exclusion, daily cover, and final cover. The design and operational elements discussed below will be included in the application for a permit to operate the site, which will be submitted to UDEQ for approval. All operational and design elements will be subject to approval by UDEQ prior to implementation at the Millard County Landfill.

8.1 Trench Configuration and Active Life

New trenches used for disposal at the Millard County Landfill are excavated approximately every two years. Each trench is excavated from the northern to the southern boundary of the site, and is laterally separated from each previous trench by 15 to 20 feet of undisturbed native soil. The plan for development of the site calls for the progression of trenches from east to west across the property.

The trenches are excavated with vertical side walls and are approximately 600 feet long by 60 feet wide by 20-25 feet deep. The surface area of an average trench is 36,000 ft^2, or 0.8 acres. The total volume of each trench is therefore approximately 33,333 cubic yards. Based on compaction rates of 1200-1400 pound per cubic yard reported in the Millard County Solid Waste Management Plan (Stansbury, 1993), and a 4:1 ratio of waste to cover soil, a trench of this size should be able to hold 16,000 tons of waste.

Information from the Management Plan (Stansbury, 1993) indicates a total of 7200 tons of incoming waste for 1992. Therefore, the current active life of an average trench at the Millard County landfill is approximately two years. The short open life and relatively small surface area of the trenches at the Millard County Landfill minimize the total amount of precipitation which is available for percolation through the waste mass and subsequent leachate generation.

8.2 Surface Water Controls

Surface water derived from precipitation will be diverted around and away from the landfill facility. Surface water diversion systems will be constructed to control the volume of flow resulting from a 24-hour, 25-year storm. All on-site surface water control structures will be maintained throughout the active life and the period of closure/post-closure to ensure continued effective operation. Prevention of run-on flow over or through the landfill will limit the amount of fluid available for percolation through the waste mass and subsequent leachate generation. As a result of these controls, the volume of precipitation directly affecting the landfill will be limited to that amount of water falling directly upon the surface area of the active trench. Overland flow will not enter or infiltrate the landfill.

8.3 Liquid Waste

The Millard County Landfill will adhere to a strict liquid waste exclusion program. The exclusion of liquid waste from the municipal waste stream will effectively limit the amount of free liquid available for leachate production within the landfill.

8.4 Daily, Interim and Final Cover

Solid waste accepted at the facility will be spread in thin layers (approximately two feet) and compacted. A minimum of six inches of cover material will be applied to the active face on a daily basis. Compaction of the wastes will decrease the potential pathways for fluid channelling within the waste mass. Consistent, daily application of cover will decrease the surface area of waste directly exposed to precipitation and will therefore minimize direct infiltration. A six-inch layer of compacted daily cover material will also enhance the capacity for retention of incoming moisture near the surface. These near-surface fluids will then be susceptible to evaporation and will be less likely to infiltrate the landfill. Interim cover will consist of a minimum of twelve inches of soil and will be applied after completion of each individual trench.

A final cover, having a permeability less than or equal to that of the natural

subsoils present, will be installed at the end of the active life of the facility. The cover will be composed of at least 18 inches of earthen material which will serve as an infiltration barrier layer, covered by at least six inches of material designed to inhibit erosion and which is capable of supporting native plant growth. The integrity of the final cover system will be inspected and maintained throughout the active life and the period of closure and post-closure. In addition, the final cover will be re-vegetated in order to stabilize the surface and inhibit infiltration. An effective final cover design combined with closure/post-closure maintenance and re-vegetation will significantly reduce the amount of infiltration into the landfill during the period of post-closure, and will limit the total volume of fluid available for leachate generation and migration.

8.5 Conclusions

The design and operational elements discussed above (trench configuration and active life, surface water controls, liquid waste exclusion, and the application of daily and final cover) all contribute to the minimization of the amount of fluid available for percolation and the processes of leachate generation. In so doing, these design and operational measures serve to protect the waters of the state from degradation, and protect human health and the environment.

9.0 HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP II)

An estimate of the quantity of leachate likely to be generated at the Millard County Landfill is essential in evaluating the need for, and appropriateness of, a ground water monitoring and liner system. Using the predicted maximum quantity of potential leachate, the potential for the landfill to impact ground or surface water can be evaluated in terms of both the geologic and hydrologic setting of the site. In addition, the cumulative total head produced by leachate accumulation at the base of the fill can be evaluated in terms of its ability to induce vertical flow through the underlying native materials. In this way, the effectiveness of native materials as a barrier to fluid flow, and their function as an ***in-situ*** liner, can be assessed.

In order to address these issues, the HELP II - Version 2.05 computer software program (Schroeder et.al., 1989) was used to model site conditions at the Millard County Landfill. The HELP model is a widely used and accepted computer program developed by the U.S. Army Corps of Engineers Waterways Experiment Station for the Environmental Protection Agency. It is a quasi-two-dimensional deterministic water budget model that uses daily climatological data, as well as site-specific material and design characteristics, to perform sequential daily analyses which determine run-off, evapotranspiration, percolation, and

lateral drainage for landfills.

9.1 Conceptual Model Used in Simulations

As discussed above in Section 8.1, the approximate configuration of the trenches used for disposal at the Millard County Landfill is 600 feet long by 60 feet wide by 20-25 feet deep. The bottom of the trench is sloped to the surface on either end and in the middle for access to the trench floor. The surface area of each trench is approximately 36,000 square feet. The life of each trench is approximately two years. HELP model simulations were run for two-year and 20-year modelling periods for purposes of comparison. A typical waste to soil ratio of 4:1 was used in defining ten alternating layers of cover soil and waste. In order to maintain this ratio and stay within the 12 layer minimum of the program, it was necessary to create waste and soil layers of exaggerated thickness. In reality, due to daily fluctuations in incoming waste volumes, the individual layers of waste and cover will actually be much thinner. Within the confines of the program, however, the end result is representative of expected site conditions.

9.2 Selection of Input Parameters

Input parameters for HELP modelling were derived from laboratory-derived data presented in Section 7.2. of this report, field-derived data presented in Appendix C of this report, published data, and default parameters provided in the software program.

Input parameters for waste were calculated from data compiled for the Winnemucca Regional Landfill in Humboldt County, Nevada, which is considered to be analogous to the Millard County Landfill in terms of climate, population served, and types of waste received. The data was taken from a study conducted by Vector (1991). During this study, a waste sort was performed at the Winnemucca Regional Landfill, and the components of the waste aggregate were reported as a percentage of the waste stream. The Winnemucca Regional Landfill currently serves a population of approximately 11,000 people. By comparison, the Millard County Landfill serves a population of approximately 12,000 people. Both landfills receive their waste from self-haul and commercial generators. The waste stream accepted at the Winnemucca Regional Landfill typically contains a higher than average percentage of food waste due to a high proportion of casinos, restaurants, and hotel/motels. Food waste is one of the major contributors of moisture to the waste stream. It is expected that the Millard County waste stream will have a lower food waste content, and therefore a lower moisture content, than that of the Winnemucca waste stream. Accordingly, the HELP model will over-estimate the actual amount of leachate produced at the Millard County Landfill. Based on the similarities between the two landfills and service areas,

information obtained during the waste sort at Winnemucca is considered to be appropriate for use in the derivation of HELP model input parameters for waste at the Millard County Landfill.

Specific gravity and initial moisture content of the site-specific solid waste stream were calculated using waste sort data from Winnemucca, in conjunction with information on the moisture content and specific gravity of individual components of the waste stream published by Tchobanoglous (1977) and Perry (1984). From this, porosity and initial moisture content (in units of vol/vol) of the waste were calculated. Data from the Winnemucca waste sort and the associated calculations are presented in Appendix C.

The calculated porosity of the waste (0.6455 vol/vol) is greater than the HELP model default value for solid waste (0.5200 vol/vol). Sensitivity analyses previously conducted with the HELP model (in-house studies, Vector Engineering) have indicated that an increase in porosity of the waste mass results in an increase in the potential volume of fluid in storage and a corresponding decrease in the predicted volume of leachate percolation from the bottom layer. Because the default value for porosity is lower than the calculated value, and would therefore tend to enhance the quantity of leachate percolating from the base of the landfill, it was selected as a conservative parameter for use in the HELP model simulations. Default values provided by the HELP model were used for all input parameters for the waste layers, with the exception of initial moisture content.

The initial moisture content of the waste was calculated using data from the landfill waste sort (Vector, 1991) and typical moisture contents of waste components published by Tchobanoglous (1977). The initial moisture content for waste was determined to be 0.1364 vol/vol; data are presented in Appendix C. This value is less than the model's default wilting point of 0.1400 vol/vol for municipal solid waste. One of the constraints of the HELP model is that the initial moisture content must be higher than the wilting point. Therefore, it was necessary to increase the initial moisture content of the waste to 0.1401 vol/vol, which is just above the default wilting point value. This adjustment results in a small, artificial decrease in the actual storage capacity of the waste, which will result in a slight increase in the amount of leachate predicted to percolate from the bottom of the waste mass.

As mentioned above, default parameters were selected to represent the cover soil layers in the landfill model. The average measured hydraulic conductivity for native soils at the landfill site was several orders of magnitude lower than that of the default soil texture chosen for cover material in the model. Soil texture #5 was chosen from the HELP model as a conservative representation of native soils which undergo excavation

and subsequent application as daily cover material. Default soil texture #5 is classified as a silty sand with a hydraulic conductivity of $1x10^{-3}$ cm/sec, which is much greater than laboratory-derived values for native soils (10^{-8} and 10^{-9} cm/sec). Selection of default soil #5 as a representation of cover soils results in a conservative (increased) prediction of fluid percolation through the waste mass.

Average monthly precipitation and temperature data were obtained from the National Weather Service Forecast Office in Salt Lake City, Utah, and are based on data collected at Delta during the years 1938-1986 (Brough, 1987). These data were used to supplement the climatic data base provided in the HELP model for Milford, Utah. Synthetically generated data for Delta is not available in the HELP model data files. Milford was chosen as the representative weather variable database because of its geographic and climatic similarity with Delta. The climate information is processed by the Agricultural Research Service's WGEN subroutine within the HELP model, and site-specific daily weather variables are generated. Additional climatic data required included leaf area index (zero for unvegetated ground), and evaporative zone depth (which was assumed to be 16 inches, or the default depth for bare soil in Milford, Utah).

Run-off is computed within the HELP model using the run-off curve-number method of the U.S. Soil Conservation Service (USDA, 1972). Based on the trench-type operation at the landfill, it was assumed that all of the precipitation falling on the area of each trench is contained within that trench, and is not allowed to run off the site.

All input parameters are summarized in the output data files for each model simulation; output files are contained in Appendix D. The following sections detail the results of the HELP modelling analyses.

9.3 Model Simulations and Results

Modelling runs were performed using the conceptual model described above for periods of two and twenty years. Although active trench life is expected to be only two years, twenty-year runs were performed in order to obtain a representative average of precipitation variances over time. These modelling runs (RUN 1 and 2, Appendix D) were performed using 10 alternating layers of cover soil and waste, as described above.

One additional simulation was performed on the same model configuration with a barrier soil liner underlying the 10 layers of soil and waste (RUN 3, Appendix D). This barrier soil liner was given the average of the laboratory-derived values for hydraulic conductivity ($2.4x10^{-8}$ cm/sec), and the average calculated value for porosity of the underlying native soils. These values are considered to be most representative of *in situ*

conditions beneath the site. It should be noted that the model automatically sets the initial soil moisture content of all barrier layers equal to the porosity, or saturation. As a result, any fluid which collects on top of the barrier layer and which generates a sufficient amount of head, will percolate from the bottom of the barrier liner.

The results of the 10-layer, two- and twenty-year simulations indicate that 0.0001 inches of leachate per unit area will percolate annually from the base of the landfill. From the results of the modelling (Appendix D) it is evident that average annual evapotranspiration is approximately 98% of average annual precipitation. Data presented in Section 4.0 indicate evaporation rates from bodies of water in the Delta area are approximately 60 inches per year, or seven to eight times the average annual precipitation. Neglecting all other processes, these data indicate that the maximum amount of potential infiltration is approximately two percent of average annual precipitation. The relatively dry conditions of the waste provide for storage of any infiltrating moisture which is not first lost to evapotranspiration. The end result is a negligible amount of percolation from the base of the waste mass.

The results of the third simulation (RUN 3, Appendix D), which included a bottom barrier soil layer, indicate that an amount of cumulative total head which is sufficient to generate and drive flow through the barrier liner was not generated during the twenty-year modelling period. An average annual percolation of 0.0001 inches per unit area (RUN 2) over a twenty year period results in the accumulation of only 0.002 inches of leachate over the barrier soil liner. Results of the simulation have shown this amount of leachate is insufficient to generate an appreciable amount of hydraulic head.

9.4 Discussion and Conclusions

As described above, conservative values were chosen for most of the input parameters in the HELP model. Values for porosity, initial moisture content, and saturated hydraulic conductivity were conservatively selected such that the calculated quantity of leachate produced would be over-estimated. Therefore, results of the model simulations are considered to be maximum values which are likely to over-estimate actual field conditions.

It should be noted that the initial moisture content of daily cover soil was set equal to field capacity within the model. The model considers fluid in excess of wilting point to be available for gravity drainage. Therefore, moisture present in the daily cover materials, as modelled, can actually contribute to the quantity of leachate calculated. This is interpreted to mean that much of the fluid which contributes to leachate production in the HELP model simulation is actually generated by gravity drainage of the

volume of initial moisture content in excess of wilting point in the soil layers. However, because daily cover material is excavated, stockpiled, spread, and left open to evaporative processes, the daily cover material under actual field conditions is likely to be significantly drier than the modelled cover soils. Therefore, actual leachate produced at the site is likely to be substantially less than predicted by the model, and is considered to be negligible.

It is beyond the scope of this investigation to quantitatively determine the rate of water movement through the unsaturated zone beneath the landfill site. Because of the variety of processes involved, which include precipitation-dissolution, sorption, redox reactions, hydrolysis, complexation, etc., such a computation would be extremely complex, even if all of the variables were known. However, based on the facts outlined below, it is reasonable to state that a negligible amount of leachate will be generated at the Millard County Landfill. It is also reasonable to conclude that this small amount of leachate is unlikely to percolate vertically through the underlying sediments. Based on the data developed through HELP model simulations, the following conclusions are reached:

- in many months, evaporation rates exceed precipitation rates, and therefore minimal quantities of fluid are available for annual infiltration into the waste mass;
- minimal amounts of leachate are likely to be generated during the short life of each trench (average output of 0.0001 inches per unit area per year);
- the calculated amount of leachate generated is considered to be in excess of actual conditions because of the highly conservative assumptions used in the modelling;
- the maximum volume of leachate likely to be produced over a twenty-year modelling period is insufficient to create the total head required to induce vertical flow through 12 inches of the underlying low permeability material; and,
- because the underlying sediments act as an *in-situ* liner and vertical penetration of leachate from the base of the landfill model has been shown to be less than 12 inches, the possibility of leachate reaching ground water is considered to be negligible.

9.5 Model Limitations

The model does not account for lateral inflow of ground water or surface water run-on. As documented is Section 7.4 of this report, ground water intrusion does not occur at the Millard County Landfill. Design plans which include the control of surface water run-on, as described in Section 8.0 of this report, will be implemented as required

for issuance of a permit to operate the facility. Therefore, neither of these model limitations are considered to be of consequence in the evaluation of leachate generation at the facility.

In addition, the model cannot simulate the possible short-circuiting of liquids through a waste mass and therefore cannot predict the quantity of leachate which may be accumulated by channeling of liquids through waste. However, as reported by Fenn et.al. (1975), the amount is expected to be small and discontinuous.

In order to compensate for the potential limitations of the HELP model as listed above, numerous conservative assumptions were made in the selection of input parameters and throughout the modelling process. As detailed in Section 9.2 above, each parameter was selected to over-estimate the final quantity of leachate likely to be produced. It is therefore concluded that, because of the highly conservative nature of the model simulations, the quantity of leachate predicted to be generated at the Millard County Landfill is over-estimated, and therefore is not undermined by the potential limitations inherent in the HELP model.

10.0 LEACHATE MIGRATION

The Utah Administrative Code requires a prediction of the fate and transport of contaminants which is maximized to reflect the potential danger to public health and safety and the environment. There are numerous physical, chemical, and biological processes which affect the fate of contaminants both within the landfill and in the subsurface. The majority of the chemical and biological processes which affect contaminant migration in the subsurface act to inhibit or slow the rate of movement of contaminants. However, there are several processes which act to increase the rate of movement of contaminants relative to the transport medium. Regardless of the effect of the process on the rate of contaminant movement, quantification of such a process is difficult at best, and requires extensive and costly studies which are beyond the scope of this project. Therefore, numerous simplifying and conservative assumptions were used in conjunction with the WHPA computer program to develop a conceptual model of the transport of ground water beneath the landfill to the nearest down-gradient well. It should be noted that the water-bearing horizon encountered during the subsurface investigation is not considered to be an aquifer. The model simulations described below are based on information obtained for the upper artesian aquifer, as described by Mower and Feltis (1968).

10.1 WHPA 2.0 Computer Model

The physical data presented in this report are insufficient to allow for a specific analysis of contaminant transport. However, an analysis which considers only the travel time of ground water within the upper artesian aquifer beneath the landfill will provide a reasonable estimate of the potential magnitude of the influence of ground water contamination on nearby pumping wells. The model used for this analysis is *WHPA, A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, Version 2.0* (U.S. EPA, 1991). This model consists of four independent computational modules: the RESSQC and MWCAP modules provide semi-analytical capture zone delineations, the GPTRAC module provides both semi-analytical and numerical options for delineating time-related capture zones, and the MONTEC module performs uncertainty analyses for a single pumping well.

10.2 Input Parameters and Assumptions

The MWCAP module was selected as appropriate for use in this study. The module uses site-specific aquifer and well characteristics in defining the areal extent of time-dependent capture zones through the particle tracking method. The use of this model requires the adoption of several assumptions regarding the system being modelled. These assumptions include the following:

- horizontal flow within the aquifer;
- homogeneous aquifer;
- steady state conditions; and,
- continuous pumping.

The first three assumptions are inherent in the model, the effects of which are accounted for by the use of conservative model input parameters. The effect of the assumption of continuous pumping on the modelling results will be to predict a much larger, conservative capture zone, if the well under study is not actually continuously pumped.

The model requires the definition of several well and aquifer input parameters. The magnitude of the hydraulic gradient (0.0038), direction of ground water flow (S. 75° W.), and aquifer transmissivity (25,000 gpd/ft) were derived from Mower and Feltis (1968). The nearest down-gradient well is approximately 1.3 miles from the landfill property and was used in the modelling exercise. This well was installed in 1955 and was originally completed as an irrigation supply well. The well was reported to have a maximum production of 1150 gallons per minute (Mower and Feltis, 1964). It was

completed to a depth of 720 feet and is reportedly out of use at this time (Pearson, 1994). Well information was obtained from Mower and Feltis (1964, 1968). The results of the modelling exercise are included in Figure 5. Some additional simplifying assumptions were necessary in order to facilitate a prediction of contaminant transport from the landfill to a nearby pumping well. A brief discussion of each assumption is included below.

- The most significant assumptions necessary to perform this analysis are: the landfill generates a significant amount of leachate; and, the leachate travels vertically through 38 to 46 feet of relatively impermeable soil to reach the confined aquifer below.

- Porosity was assumed to be 0.30 for a silty sand (Domenico & Schwartz, 1990).

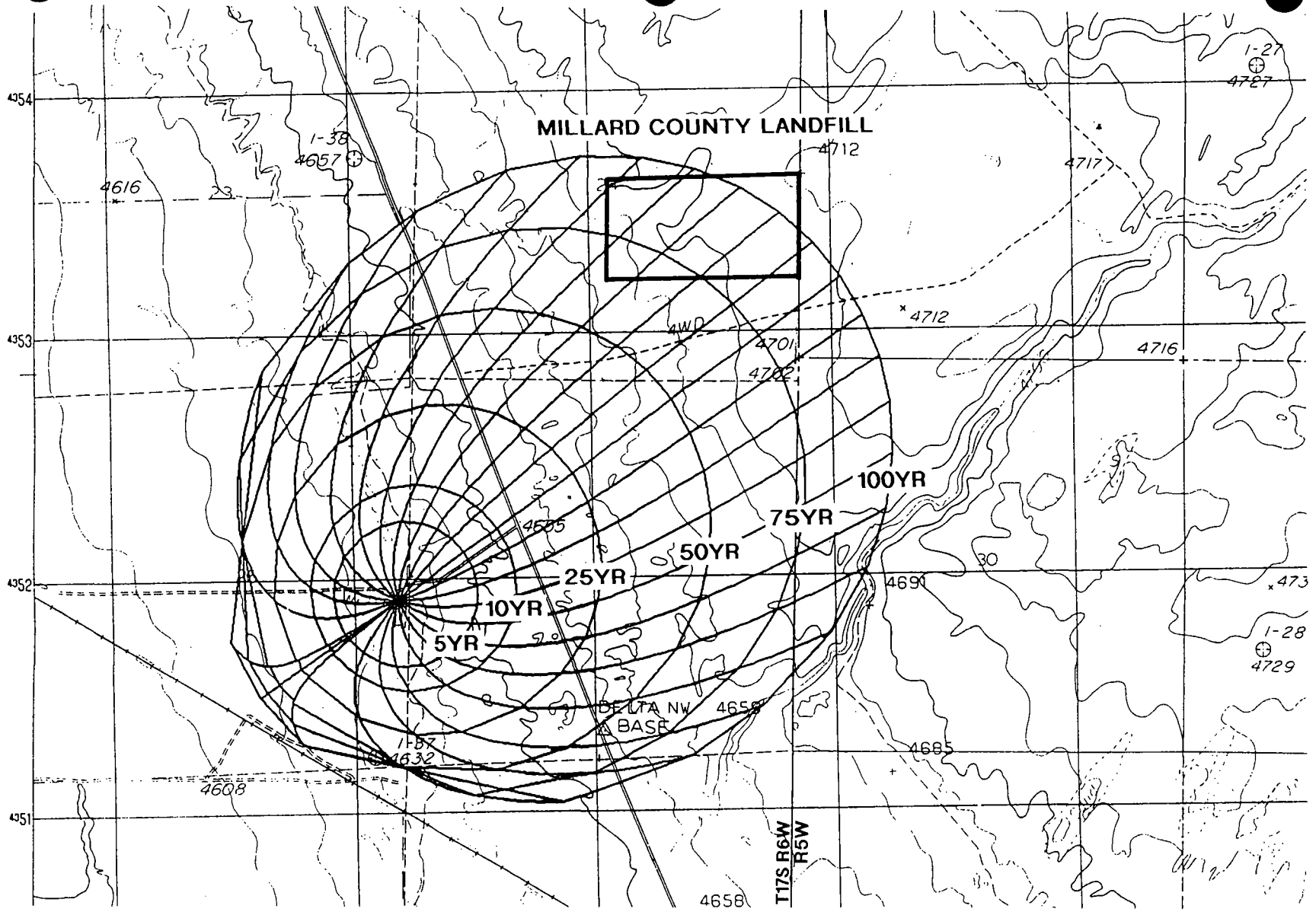
- The aquifer thickness was assumed to be the total thickness of all sand layers described in boring logs from the original well installation (Mower and Feltis, 1964). If aquifer thickness is artificially increased, a smaller capture zone will be defined. Therefore, in the interest of a conservative prediction, the thicker screened interval described in Mower and Feltis (1964) was not used as the aquifer thickness in the modelling analysis.

- The approach described in this exercise considers only the horizontal movement of water in the saturated zone, and does not consider vertical flow in the unsaturated zone between the landfill and ground water, chemical or physical properties of contaminants, or any other process which may effect fluid or contaminant migration, such as precipitation-dissolution, sorption, adhesion, dispersion, etc.

10.3 WHPA Modelling Results

The well used in the analysis, as described above, was given the yield rate provided in Mower and Feltis (1964), or an irrigation well pumping rate of 1150 gallons per minute. The pump is considered in the model to run twenty-four hours per day, 365 days per year.

Model simulations were performed for five, 10, 25, 50, and 100 year capture zones. The model defines the areal extent of the capture zone based on well and ground water parameters. The results of the analyses are presented in Figures 5 and 6. The nearest down-gradient well is not directly down-gradient from the landfill. However, due



SCALE: 1" = 2000'

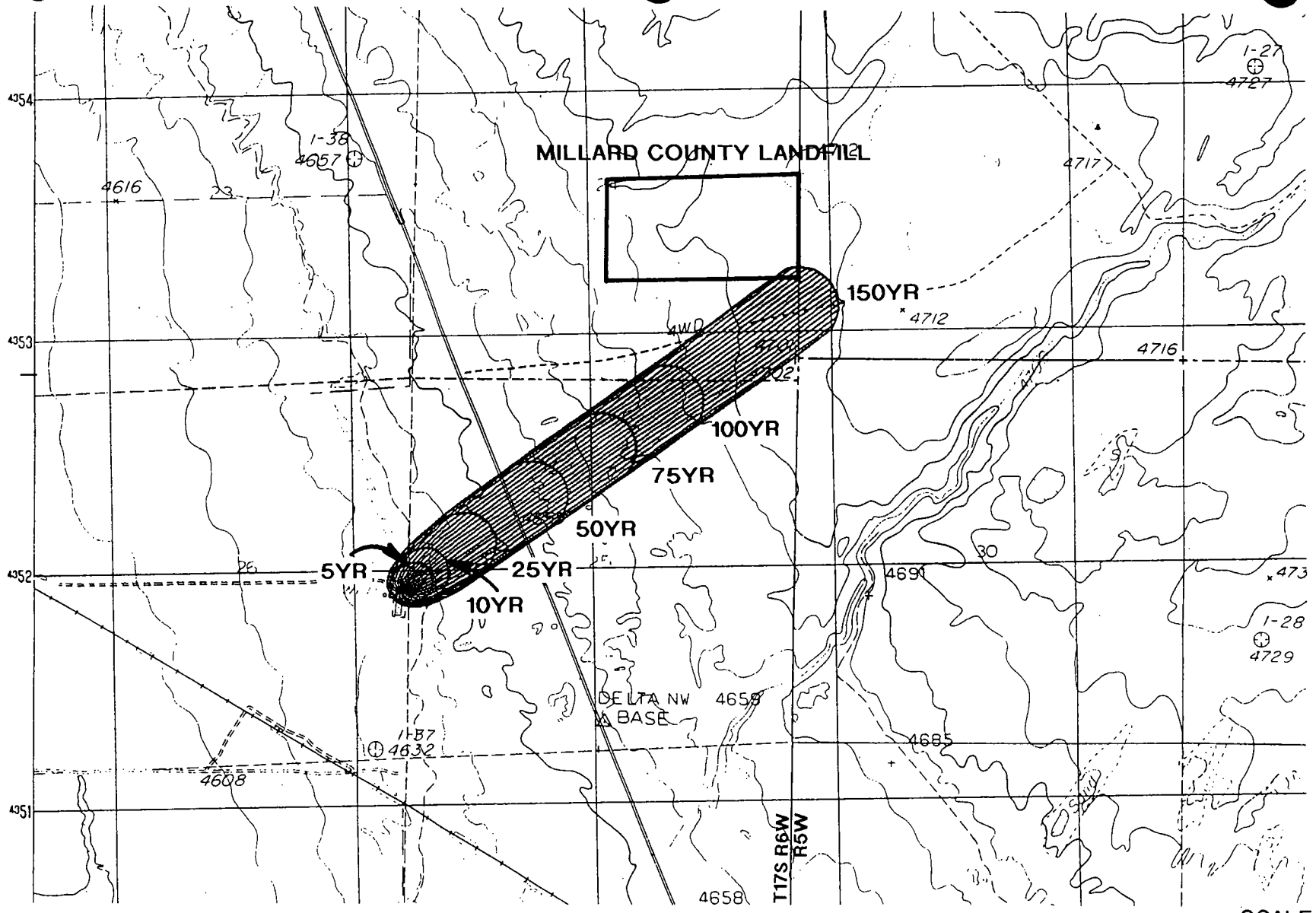
CONTOUR INTERVAL = 10'
BASE MAP FROM USGS HARDING QUADRANGLE (1985)

VECTOR ENGINEERING, INC Grass Valley, CA • El Dorado Hills, CA • Carson City, NV JOB NO. 94-5013.00 Ph. 5.0 DATE: 11/3/94	MILLARD COUNTY LANDFILL **WHPA Modelling Results: Irrigation Well**	FIGURE 5

to the shape of the capture zones depicted in Figures 5 and 6, a well placed at a similar distance and directly down-gradient from the landfill will require only a slightly shorter period of time for a particle which originates in the aquifer directly beneath the landfill to travel to the pumping well. As depicted in Figure 5, and based on numerous conservative assumptions to allow for this analysis, water particles from a point in the aquifer beneath the landfill will reach the pumping well after 50 to 75 years of continuous pumping. The time of travel from the current active portion of the landfill is between 75 and 100 years. Realistically, since irrigation wells typically operate less than six months out of the year, and commonly less than twenty-four hours per day, the predicted time for particle travel may be three to four times this amount, or 150 to 300 years.

Additional model simulations were run using a conservative domestic well production rate of 80 gallons per minute as a means of comparison. The result, illustrated in Figure 6, was a series of capture zones which were smaller and narrower than those defined for the irrigation well. The largest capture zone, defined for a 150-year period, intersected the southeast corner of the landfill property . The delineation of these captures zones also assumes continuous pumping. Similar to the irrigation well discussed above, domestic wells are commonly not operated continuously. Therefore, the actual travel time of a particle of water from a point in the aquifer beneath the landfill to the pumping well may be two to three times the predicted amount, or 300 to 450 years.

The estimates of fluid migration rates presented above provide very simplified approximations of a complex system. The processes which control the migration of contaminants in the subsurface are complicated and cannot be easily represented by the use of general, simplifying assumptions. As mentioned above, these ground water flow simulations represent the movement of ground water only, and do not represent estimates of the rate of contaminant movement in the subsurface. This exercise is intended as a first order approximation of the magnitude and scale of the problem, that of the potential influence of any leachate which may be generated at the Millard County Landfill.



CONTOUR INTERVAL = 10'
BASE MAP FROM USGS HARDING QUADRANGLE (1985)

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MILLARD COUNTY LANDFILL

WHPA Modelling Results: Domestic Well

FIGURE **6**

11.0 SUMMARY AND CONCLUSIONS

Published and unpublished data on the regional and local hydrologic and geologic setting of the Millard County Landfill were reviewed, and a detailed site investigation was developed and completed. The volume of leachate potentially generated at the Millard County Landfill was modelled using the HELP II - Version 2.05 software program. In addition, the potential magnitude of influence of ground water contamination on down-gradient wells was assessed using the WHPA computer program. These investigations were designed to evaluate a number of items which are of concern in the development of a sound technical justification for a waiver from ground water monitoring and liner requirements.

Results of this site-specific study indicate that operation of the Millard County Landfill is unlikely to cause degradation of waters of the state, or to endanger human health or the environment. The supporting data can be separated into three overlapping areas of concern: hydrogeologic setting, design and operational elements, and HELP II modelling of the potential leachate generated at the site. These data are outlined below.

Hydrogeologic Data
Hydrogeologic data presented in this report which support approval of a waiver from ground water monitoring and liner requirements include the following:

- the lithologic section beneath the Millard County Landfill was shown to contain numerous layers of relatively impermeable silty clay and clayey silt;
- subsurface layers are laterally continuous on the scale of the landfill property;
- ground water exists beneath the site at depths ranging from 63 to 71 feet, or from 38 to 46 feet below the base of existing and future fill;
- ground water beneath the site exists under confined or semi-confined conditions with an average pressure head of 7.5 feet;
- laboratory analyses of the clay and silt layers beneath the site resulted in permeabilities of $1x10^{-8}$ and $5x10^{-8}$ cm/sec for silty clay, and $5.2x10^{-9}$ cm/sec for clayey silt/lean clay; and,
- the large thickness and low permeability of the underlying sediments exceed the alternative bottom liner requirements (UAC Section R315-303-4(3)(b)) of three feet of compacted soil having a permeability less than or equal to $1x10^{-7}$ cm/sec, and

therefore act as an *in-situ* liner system.

Design and Operational Elements

Landfill design and operational elements have been specified which will greatly reduce the volume of fluid available for percolation through the waste mass and will therefore inhibit the generation of leachate at the site. Detailed plans will be submitted to Utah DEQ for review and approval prior to February 1, 1995, as part of an application for a permit to operate. Pertinent elements of these plans are summarized below:

- relatively small trench size and short active life;
- compliance with design standards for surface water controls;
- exclusion of liquid wastes from the disposal site; and,
- daily cover application and installation of final cover.

HELP II Modelling

Results of the HELP II modelling indicate the following:

- in most months, evaporation rates exceed precipitation rates, and therefore minimal quantities of fluid are available for annual infiltration into the waste mass;
- minimal amounts of leachate are likely to be generated during the life of the landfill (average output of 0.0001 inches per unit area per year);
- the calculated amount of leachate generated is considered to be in excess of actual conditions because of the highly conservative assumptions used in the modelling;
- the maximum volume of leachate likely to be produced over the total life of the landfill is insufficient to create the total head required to induce vertical flow through 12 inches of the underlying low permeability material; and,
- because the underlying low-permeability sediments act as an *in-situ* liner and vertical penetration of leachate has been shown to be less than 12 inches, the possibility of leachate reaching ground water is considered to be negligible.

WHPA Modelling

Results of the WHPA modelling indicate the following:

- conservative modelling using irrigation flow rates resulted in an estimated travel time of 150 to 300 years for water to travel from a point in the aquifer beneath the landfill to the nearest down-gradient well; and,

- modelling using typical domestic flow rates resulted in a 150-year capture zone which intersected the southeast corner of the landfill property; an estimate of actual travel time based on non-continuous pumping, is approximately 300 to 450 years.

Based on the data submitted in this report, it is highly unlikely that operation of the Millard County Landfill will generate a sufficient amount of leachate to contaminate ground water underlying the site. Millard County is therefore requesting approval of operation of the Millard County Landfill without installation of a ground water monitoring or liner system, as provided by Sections R315-308-1(3) and R315-303-4(3)(c) of the Utah Administrative Code.

12.0 LIMITATIONS

This report was prepared in accordance with generally accepted geologic practices applicable at the time of preparation. Conclusions presented in this report are specific for this site and this client, and may not be expanded to include areas beyond this site. Vector Engineering, Inc., makes no other warranties, expressed or implied, as to the professional advice provided in this report.

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APPENDIX A
Drilling Logs

LOG OF BORING B-1

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	
						CL	4 to 6 inch layer, Light Olive Grey CLAY (CL), very silty, moist
						ML	
	20 50/4"			■			
35							
						CL	6 to 10 inch layer Grey very Silty CLAY (CL), moist
						ML	
						CL	3 inch layer silty clay
	17 32 47			☒		CL ML	Very Silty CLAY interbedded with Slightly Clayey SILT (ML) oxidized along bedding planes and fractures
40						CL	Red-Brown very Silty CLAY (CL)
						ML	Light Brown Clayey SILT (ML)
						CL	Red-Brown very Silty CLAY (CL)
	15 50/5"			■		ML CL	Interbedded Clayey SILT/Silty CLAY (ML/CL), slightly moist, highly oxidized bands apparently along bedding,
45							
						ML	Light Brown Sandy SILT (ML), with very fine sand, dry to slightly moist
	25 50/5"			■			
50							
	8 18 26			■			with dark oxidation in fractures, possibly old dessication cracks
55							with very clayey layers interbedded
	13 17 19			☒			
60							

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Grass Valley, CA. 95945
(916) 272-2448

PROJECT Millard County
LOCATION Millard County Landfill
JOB NUMBER 94.5013.00
LOGGED BY RBB
DRILL RIG CME 55

DRILLING COMPANY Mountain States Drilling
HAMMER DATA 140 lbs.
DATE DRILLED 8/23/94
TOTAL DEPTH OF HOLE 77 Feet
WATER ENCOUNTERED NFWE

LOG OF BORING B-1

PLATE

Page 1

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	Light Brown Sandy SILT, (ML), slightly moist, dense, moderately indurated
5	11 35 50/5"			■			light Brown clayey silt with high clay content/ bordering on silty clay, very little sand, shows very small spots of oxidation
10							with thin (approx. 1 cm) interbeds of clay
15							
	20 50/6"			■			
20							returned small chunks of moist clay, very few still shows oxidation (appears to be small interbeds of clay on the order of 1-2 cm thick, all other is clayey silt)
	25 50/4"			■			
25							
	25 50/2"			■			small spots $CaCo^3$ thin clay layers, trace of oxidation
30							

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DRILLING COMPANY Mountain States Drilling
HAMMER DATA 140 lbs.
DATE DRILLED 8/23/94
TOTAL DEPTH OF HOLE 77 Feet
WATER ENCOUNTERED NFWE

LOG OF BORING B-2

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	Light Brown Clayey SILT (ML), slightly moist, dense to very dense, varying clay contact; oxidized stringers
5	17 50/3"			■			(switching to air rotary)
10							
15						CL ML	small CLAY layer at 15.5, 4-6 inches
	27 50/5"			■		CL ML	small CLAY layer, 2-4 inches
20							clayey silt thin clay layer
	26 50/5"			■			with thin clay interbeds about 1-2 inches
25						CL ML	clay layer, very silty, 6-10 inches
	30 50/3"						oxidized along fractures with small crystalline and splotchy CaCo3
30							

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PROJECT	Millard County	DRILLING COMPANY	Mountain States Drilling
LOCATION	Millard County Landfill	HAMMER DATA	140 lbs.
JOB NUMBER	94.5013.00	DATE DRILLED	8/24/94
LOGGED BY	RBB	TOTAL DEPTH OF HOLE	82.5 Feet
DRILL RIG	CME 55	WATER ENCOUNTERED	FWE

LOG OF BORING B-1

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	oxidation in spots - not cracks
						ML	very thin seam of Black volcanic sand, dry, (maybe 1-2")
65							dry to slightly moist, very easy drilling last 2 feet from from 65.5 to 67.5, very thinly bedded with trace of black sand
70							light Olive Brown, high $CaCo^3$ content gives whitish appearance, trace of gravel and black sands/high clay content
							lost circulation
75							regained circulation in "sticky" layer at 77.0 feet
							TEST BORING TERMINATED AT 77.0 FEET No Free Water Encountered
80							Note: Returned in a.m. on 8/24/94 to check water level. Water at 69.0 feet, bottom of hole apparently caved to 71.5 feet. Possible small perched zone overlaying clay. Sticky layer at 77.0 feet did not give way to drilling and immediately clogged pipe (not enough compressor pressure)
85							
90							

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LOCATION	Millard County Landfill	HAMMER DATA	140 lbs.
JOB NUMBER	94.5013.00	DATE DRILLED	8/23/94
LOGGED BY	RBB	TOTAL DEPTH OF HOLE	77 Feet
DRILL RIG	CME 55	WATER ENCOUNTERED	NFWE

LOG OF BORING B-2

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	lost circulation (note: no pressure buildup initially and then plugged bit)
							moist to wet
	19 17 15			☒			▽free water encountered, very sandy note: water returned after sampling, but only for about a 1 foot zone
65						SM	Light Reddish Brown, very fine, very Silty SAND (SM), with Black volcanic particles, poorly indurated
							hole made a couple of gallons during pipe addition
							very sandy silt returned during initial blowout
70							
							hole making good water after each stop, on the order of 5 gpm gallons per minute (estimated)
75							
							making water continuously while drilling, measured 1.5 min/5 gal. or 3.33 gpm, seems to be increasing with increasing depth
80							
							TEST BORING TERMINATED AT 82.5 FEET Free Water Encountered at 62.5 Feet
85							water measured at 5 gpm *WATER MEASUREMENT* 15 min. 55 feet 20 min. 55 feet
							Note: Hole caved at 63.0 feet
90							

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DRILLING COMPANY Mountain States Drilling
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DATE DRILLED 8/24/94
TOTAL DEPTH OF HOLE 82.5 Feet
WATER ENCOUNTERED FWE

LOG OF BORING B-2

PLATE

Page 2 of

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	slightly moist with moist clay interbeds, 1-2cm (more frequent)
	23 50/3"			■			
						CL	Brown very Silty CLAY (CL), moist
35						ML	Light Brown Sandy SILT (ML), slightly moist
	20 50/5"			■			
40						SM	4-6" zone - Black volcanic sand, very fine, slightly moist
						CH	Light Olive Grey to White very Silty CLAY (CH), moist
	4 7 10			■			moist to wet
45						SM	Light Brown Silty SAND with some gravel (volcanic sand), dry to slightly moist (gravel appears to be small sub-angular to sub-rounded fragments of Basalt and Quartzite)
	23 50			■			trace of gravel, slightly moist
50							coarse with gravel, moist
						ML	Light Brown Sandy SILT (ML), moist with trace of Black Volcanic sand)
55							with more sand and a trace gravel
60							

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PROJECT	Millard County	DRILLING COMPANY	Mountain States Drilling
LOCATION	Millard County Landfill	HAMMER DATA	140 lbs.
JOB NUMBER	94.5013.00	DATE DRILLED	8/24/94
LOGGED BY	RBB	TOTAL DEPTH OF HOLE	82.5 Feet
DRILL RIG	CME 55	WATER ENCOUNTERED	FWE

LOG OF BORING B-3

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
95	27 45 50/4"			■		SM	note: water measured at 5 gal./1:22 or 4 gpm note: caved approx. 12 feet during a 15 min. break note: water measured at 5 gpm
100						ML	Light Brown clayey SILT (ML), confining layer, too sticky, clogging bit *TEST PIT TERMINATED AT 97.5 FEET* Free Water Encountered at 71 feet *WATER DEPTH AFTER DRILLING* *20 MIN. Water @ 65.5 feet* *Bottom @ 93.0 feet* *30 MIN. Water @ 64.0 feet* *Note: static water equilibrium at 64.0 feet*
105							
110							
115							
120							

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PROJECT Millard County
LOCATION Millard County Landfill
JOB NUMBER 94.5013.00
LOGGED BY RBB
DRILL RIG CME 55

DRILLING COMPANY Mountain States Drilling
HAMMER DATA 140 lbs.
DATE DRILLED 8/24,25/94
TOTAL DEPTH OF HOLE 97.5 Feet
WATER ENCOUNTERED FWE

LOG OF BORING B-3

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	
						SM	Light Brown very Silty SAND (SM), moist, very fine grained, zones of varying moisture content
65							very high silt content with trace gravel and black sand
						ML	Brown very Sandy SILT (ML) with trace of clay and black volcanic sand, trace of basalt, gravel to 1/2"
							note: circulation lost in this interval without pressure buildup, (could be clogged hole) very sandy - possibly thinly bedded, fine grained sands and silts
70							note: pulled 30' of pipe to re-ream hole, water returned upon re-entry after re-reaming hole
							▽ free water encountered at 71.0 feet
						SM	Light Reddish Brown very Silty SAND, slightly indurated
75							note: hole starting to make water
							Silty sand with interbedded sandy silt
80							
85							
90							

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PROJECT Millard County
LOCATION Millard County Landfill
JOB NUMBER 94.5013.00
LOGGED BY RBB
DRILL RIG CME 55

DRILLING COMPANY Mountain States Drilling
HAMMER DATA 140 lbs.
DATE DRILLED 8/24,25/94
TOTAL DEPTH OF HOLE 97.5 Feet
WATER ENCOUNTERED FWE

LOG OF BORING B-3

PLATE

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
						ML	
						CL	6" clay layer
						ML	Light Brown Clayey SILT
35						CL	6-10" clay layer
						ML	Light Brown Clayey SILT
40						ML/CL	Brown Clayey SILT/Silty CLAY (ML/CL), borderline, very high clay content, slightly moist
						ML	Light Brown Clayey SILT (ML), dense to very dense, slightly moist with oxidation stringers and clay interbeds
45							
50						CH	3" layer Black volcanic sand
							Light Olive Grey to White *very* Silty CLAY (CH), moist, stiff
	20 31 36			■		SM	Light Brown to Light Grey Silty SAND (SM) with volcanic gravel, very silty, (trace of black sand), dry to slightly moist (with pea sized gravel)
55							Note: lost circulation but no pressure buildup and no plugging
							varying silt content (Note: dry hole upon re-entry the following morning)
60						ML	Light Brown very Sandy SILT (ML), moist

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PROJECT	Millard County	DRILLING COMPANY	Mountain States Drilling
LOCATION	Millard County Landfill	HAMMER DATA	140 lbs.
JOB NUMBER	94.5013.00	DATE DRILLED	8/24,25/94
LOGGED BY	RBB	TOTAL DEPTH OF HOLE	97.5 Feet
DRILL RIG	CME 55	WATER ENCOUNTERED	FWE

LOG OF BORING B-3

PLATE

Page 1

DEPTH (feet)	BLOWS/6 in.	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SAMPLES	GRAPHIC LOG	USCS SOIL CLASS	MATERIALS DESCRIPTION
5	9 20 32			☒		ML CL	Brown Silty CLAY/Clayey SILT (ML/CL), (borderline), slightly moist, dense/stiff to very dense thinly interbedded clayey silt and silty clay showing oxidized stringers
						ML	Light Brown Clayey SILT (ML), slightly moist, dense to very dense, with thin interbeds of very silty clay
10							
15							
	15 40 50/3"						
20						CL ML	4-6" Silty Clay Layer Light Brown Clayey SILT
25							
						CL ML	6" clay layer Light Brown Clayey SILT
30							

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PROJECT	Millard County	DRILLING COMPANY	Mountain States Drilling
LOCATION	Millard County Landfill	HAMMER DATA	140 lbs.
JOB NUMBER	94.5013.00	DATE DRILLED	8/24,25/94
LOGGED BY	RBB	TOTAL DEPTH OF HOLE	97.5 Feet
DRILL RIG	CME 55	WATER ENCOUNTERED	FWE

APPENDIX B
Results of Laboratory Analyses

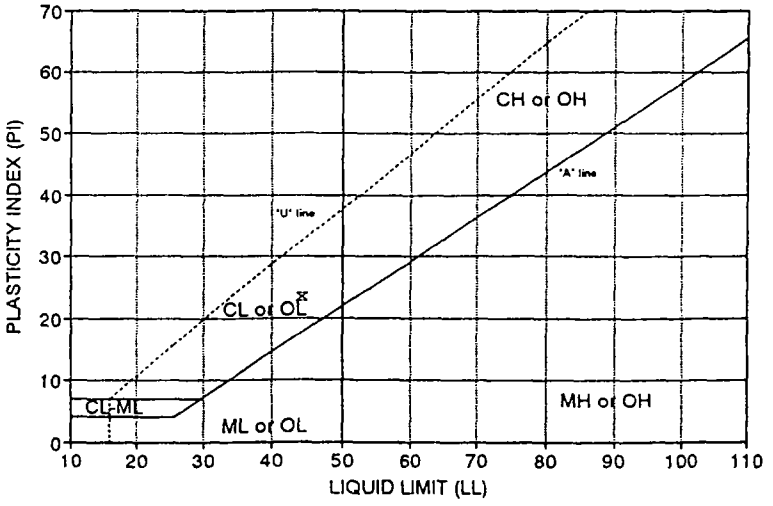
ATTERBERG LIMITS TEST DATA

PROJECT NAME	MILLARD COUNTY, UTAH	LAB LOG NO.	936A
PROJECT NO.	945013.00	DATE:	09/20/94
SAMPLE ID	B-1 @ 28.0'	ENTERED BY:	DSJ
SOIL DESCRIPTION	TAN LEAN CLAY (CL)		

LIQUID LIMIT					
TRIAL NUMBER	1	2	3	4	5
DISH NUMBER					
WEIGHT WET SOIL + DISH	24.44	21.68	24.57	0.00	0.00
WEIGHT DRY SOIL + DISH	20.62	18.51	20.44	0.00	0.00
WEIGHT OF WATER	3.82	3.17	4.13	0.00	0.00
WEIGHT OF DISH	11.61	11.42	11.45	0.00	0.00
WEIGHT OF DRY SOIL	9.01	7.09	8.99	0.00	0.00
WATER CONTENT %	42.40	44.71	45.94		
NUMBER OF BLOWS	35	26	16		

PLASTIC LIMIT				TEST SUMMARY	
TRIAL NUMBER	1	2	3	LIQUID LIMIT:	
DISH NUMBER				(Ave.)	44.2
WEIGHT WET SOIL + DISH	11.20	11.33	0.00	(Curve)	44.3
WEIGHT DRY SOIL + DISH	10.01	10.12	0.00	PLASTIC LIMIT:	
WEIGHT OF WATER	1.19	1.21	0.00		20.9
WEIGHT OF DISH	4.32	4.30	0.00	PLASTICITY INDEX:	
WEIGHT OF DRY SOIL	5.69	5.82	0.00		23.4
WATER CONTENT %	20.91	20.79	0.00	CLASSIFICATION:	
WATER CONTENT, AVERAGE	20.85				CL or OL

PLASTICITY CHART



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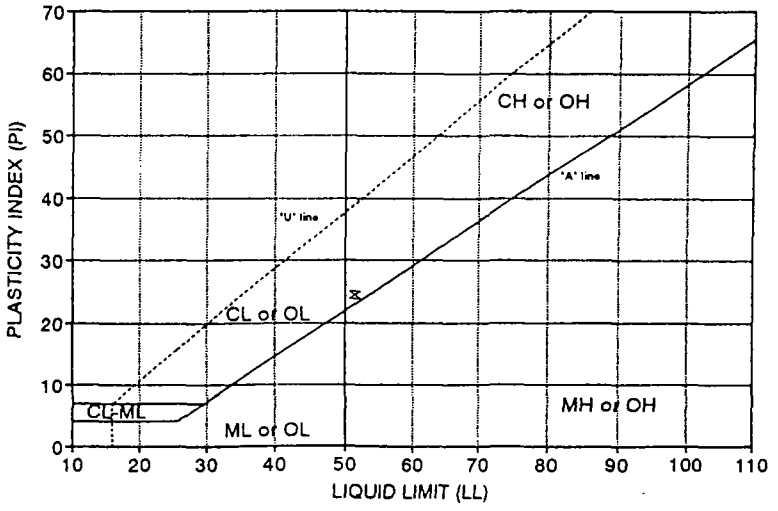
ATTERBERG LIMITS TEST DATA

PROJECT NAME	MILLARD COUNTY, UTAH	LAB LOG NO.	936C
PROJECT NO.	945013.00	DATE:	09/20/94
SAMPLE ID	B-2 @ 43.0'	ENTERED BY:	DSJ
SOIL DESCRIPTION	GRAY FAT CLAY (CH)		

LIQUID LIMIT					
TRIAL NUMBER	1	2	3	4	5
DISH NUMBER					
WEIGHT WET SOIL + DISH	23.30	29.71	28.71	0.00	0.00
WEIGHT DRY SOIL + DISH	19.34	25.09	24.25	0.00	0.00
WEIGHT OF WATER	3.96	4.62	4.46	0.00	0.00
WEIGHT OF DISH	11.45	16.02	16.05	0.00	0.00
WEIGHT OF DRY SOIL	7.89	9.07	8.20	0.00	0.00
WATER CONTENT %	50.19	50.94	54.39		
NUMBER OF BLOWS	35	26	16		

PLASTIC LIMIT				TEST SUMMARY	
TRIAL NUMBER	1	2	3	LIQUID LIMIT:	
DISH NUMBER				(Ave.)	51.7
WEIGHT WET SOIL + DISH	13.76	13.74	0.00	(Curve)	51.5
WEIGHT DRY SOIL + DISH	12.22	12.15	0.00	PLASTIC LIMIT:	
WEIGHT OF WATER	1.54	1.59	0.00		27.1
WEIGHT OF DISH	6.53	6.31	0.00	PLASTICITY INDEX:	
WEIGHT OF DRY SOIL	5.69	5.84	0.00		24.4
WATER CONTENT %	27.07	27.23	0.00	CLASSIFICATION:	
WATER CONTENT, AVERAGE	27.15				CH or OH

PLASTICITY CHART



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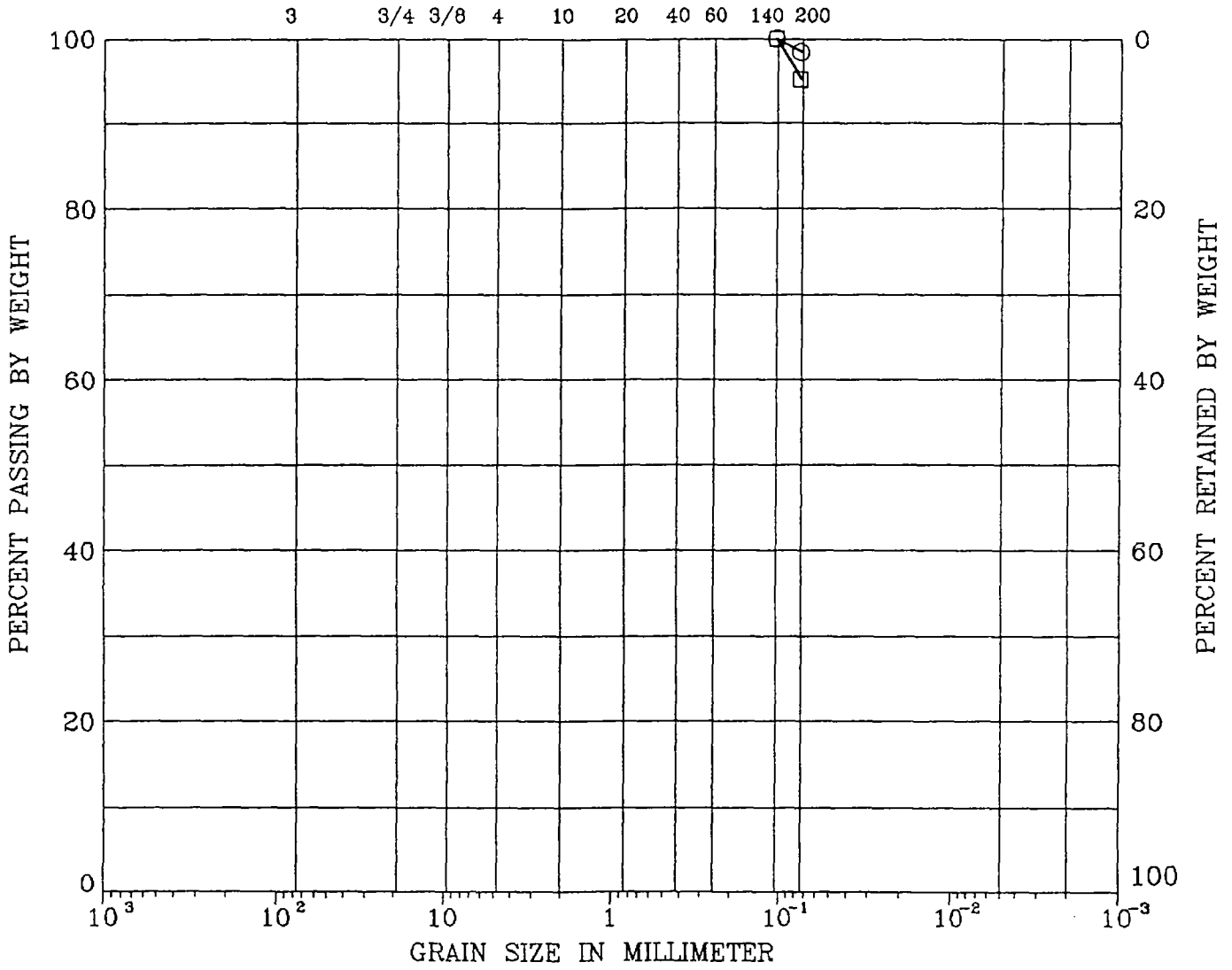
UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	B-1	28.0	44	23	Tan Lean Clay (CL)
□	B-2	43.0	51	24	Gray Fat Clay (CH)

Remark : Minus No. 200 Sieve Wash

Proj. No. 945013.0	MILLARD COUNTY, UTAH
Vector Engineering	GRAIN SIZE DISTRIBUTION Lab File 936

VECTOR
ENGINEERING, INC.

PERMEABILITY TEST REPORT

Client Name: MILLARD COUNTY, UTAH *Project No.:* 945013.00-936

Project Name: *Test Type:* ASTM D-5084

Date: SEPT. 19, 1994

SOURCE LOCATION	MOISTURE CONTENT Initial/final (%)	DRY DENSITY initial/final (pcf)	HYDRAULIC GRADIENT	EFFECTIVE CONSOLIDATION PRESSURE (psi)	HYDRAULIC CONDUCTIVITY (cm/sec)
B-1 @ 28.0'					Too Disturbed
B-1 @ 53.0'	22.2 / 22.6	105 / 105	13-40	25	1 x 10-8
B-2 @ 43.0'	40.6 / 40.6	79 / 80	19-45	25	5 x 10-8

NOTES: De-aired tap water was used as permeant.

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VECTOR
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PERMEABILITY TEST REPORT

Client Name: MILLARD COUNTY | *Project No.:* 945013.00-965

Project Name: | *Test Type:* ASTM D-5084

Date: OCT. 18, 1994

SOURCE LOCATION	MOISTURE CONTENT initial/final (%)	DRY DENSITY initial/final (pcf)	HYDRAULIC GRADIENT	EFFECTIVE CONSOLIDATION PRESSURE (psi)	HYDRAULIC CONDUCTIVITY (cm/sec)
B-1 @ 32.5'	14.7 / 22.1	111 / 102	25-26	25	6.4 E-9

NOTES: De-aired tap water was used as permeant.

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TRIAXIAL PERMEABILITY

QUALITY CONTROL CHECK

Client Name: MILLARD COUNTY Project: ; No. 945013.00

Sample I.D.: B-1 @ 32.5' Soil Description:

MOISTURE DATA	Before Test		After Test			TEST DATA	
	Specimen	Trimmings	Specimen	Washings	Total		
Tare + Wet Soil Wt. (gm):		0.00	384.70			Specific Gravity	2.70
Tare + Dry Soil Wt. (gm):			329.00	77.47		Chamber Pressure (psi)	85.00
Moisture Loss Wt. (gm):		0.00	55.70			Back Pressure (psi)	60.00
Tare Weight (gm):			76.70	77.40		Eff. Consol Press. (psi)	25.00
Wet Soil Weight (gm):	289.37	0.00	308.00		308.09	Burette Area (cm2)	0.5027
Dry Soil Weight (gm):	252.37	0.00	252.30	0.07	252.37	C Factor (Final)	0.09548
Moisture Content (%):	14.66	ERR	22.08		22.08	"B" Check	0.95

SPECIMEN DATA		Initial	Change	Saturated	Change	Consolidated	Change	Final
Sample Length (in.)		2.985				3.010		3.010
Sample Diameter (in.)		1.926				1.962		1.993
Sample Length (cm)		7.58				7.65		7.65
Sample Diameter (cm)		4.89				4.98		5.06
Sample Area (cm2)		18.80				19.51		20.13
Dial Reading (cm)								
Burette Reading (cm)				88.80	6.40	95.20		
Solids Weight (cc)	Ws	252.37		252.37		252.37		252.37
Volume Total (cc)	Vt	142.51	13.07	155.59	6.40	149.19	4.69	153.88
Volume Solids (cc)	Vs	93.47		93.47		93.47		93.47
Volume Voids (cc)	Vv	49.04		62.12		55.72		60.41
Volume Water (cc)	Vw	37.00		62.12		55.72		55.72
Void Ratio	e	0.525		0.665		0.596		0.646
Saturation (%)	S	75.45		100.00		100.00		92.23
Porosity (%)	n	34.38		39.89		37.32		39.23
Moisture Content (%)	M%	14.66		24.61		22.08		22.08
Wet Density (pcf)	Dw	126.76		126.19		128.92		124.99
Dry Density (pcf)	Dd	110.56		101.27		105.61		102.39

#	Day	Hrs.	Min.	Time Change t (sec.)	In Burette Reading	In Change / Out Change	Out Burette Reading	Burette Change (In-Out)	Air Head (psi)	Total Head h (cm)	Hydraulic Gradient	Hydraulic Conductivity k(cm/sec)
		12	23	0	95.2	0.1	39.7	55.5	2	196.1	26	
1.		14	0	5820	95.1	0.1	39.8	55.3	2	195.9	26	1.67e-8
		14	0	0	95.1	0.4	39.8	55.3	2	195.9	26	
2.	1	9	7	68820	94.7	0.2	40.0	54.7	2	195.3	26	4.26e-9
		9	7	0	94.7	0.4	40.0	54.7	2	195.3	26	
3.	1	8	8	82860	94.3	0.0	40.0	54.3	2	194.9	25	2.36e-9
		8	8	0	94.3	0.1	40.0	54.3	2	194.9	25	
4.		12	51	16980	94.2	0.1	40.1	54.1	2	194.7	25	5.77e-9
		12	51	0	94.2	0.2	40.1	54.1	2	194.7	25	
5.		16	16	12300	94.0	0.1	40.2	53.8	2	194.4	25	1.20e-8
		16	16	0	94.0	0.3	40.2	53.8	2	194.4	25	
6.	1	7	59	56580	93.7	0.0	40.2	53.5	2	194.1	25	2.61e-9
		7	59	0	93.7	0.1	40.2	53.5	2	194.1	25	
7.		12	41	16920	93.6	0.0	40.2	53.4	2	194.0	25	2.91e-9
		12	41	0	93.6	0.3	40.2	53.4	2	194.0	25	
8.	1	7	32	67860	93.3	0.1	40.3	53.0	2	193.6	25	2.90e-9
		7	32	0	93.3	0.2	40.3	53.0	2	193.6	25	
9.		14	10	23880	93.1	0.1	40.4	52.7	2	193.3	25	6.20e-9
		14	10	0	93.1	0.1	40.4	52.7	2	193.3	25	
10.		17	39	12540	93.0	0.1	40.5	52.5	2	193.1	25	7.88e-9

NOTES: ASTM D-5084

Gradient Range (high) 26 (low) 25

AVERAGE PERMEABILITY: 6.4e-9

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TRIAXIAL PERMEABILITY

QUALITY CONTROL CHECK

Client Name: MILLARD COUNTY, UTAH

Project: ; No. 945013.00

Sample I.D.: B-1 @ 53.0'

Soil Description:

MOISTURE DATA	Before Test		After Test			TEST DATA	
	Specimen	Trimmings	Specimen	Washings	Total		
Tare + Wet Soil Wt. (gm):		75.67	376.10			Specific Gravity	2.70
Tare + Dry Soil Wt. (gm):		62.36	321.70	77.95		Chamber Pressure (psi)	85.00
Moisture Loss Wt. (gm):		13.31	54.40			Back Pressure (psi)	60.00
Tare Weight (gm):		8.56	81.19	77.78		Eff. Consol Press. (psi)	25.00
Wet Soil Weight (gm):	294.00	67.11	294.91		295.12	Burette Area (cm2)	0.5027
Dry Soil Weight (gm):	240.68	53.80	240.51	0.17	240.68	C Factor (Final)	0.10052
Moisture Content (%):	22.15	24.74	22.62		22.62	"B" Check	0.92

SPECIMEN DATA		Initial	Change	Saturated	Change	Consolidated	Change	Final
Sample Length (in.)		2.999				2.978		2.978
Sample Diameter (in.)		1.922				1.935		1.932
Sample Length (cm)		7.62				7.56		7.56
Sample Diameter (cm)		4.88				4.92		4.91
Sample Area (cm2)		18.72				18.98		18.91
Dial Reading (cm)								
Burette Reading (cm)				54.00	15.40	69.40		
Solids Weight (cc)	Ws	240.68		240.68		240.68		240.68
Volume Total (cc)	Vt	142.59	16.39	158.98	15.40	143.58	-0.52	143.06
Volume Solids (cc)	Vs	89.14		89.14		89.14		89.14
Volume Voids (cc)	Vv	53.44		69.84		54.44		53.92
Volume Water (cc)	Vw	53.32		69.84		54.44		54.44
Void Ratio	e	0.600		0.783		0.611		0.605
Saturation (%)	S	99.77		100.00		100.00		100.96
Porosity (%)	n	37.45		43.90		37.89		37.66
Moisture Content (%)	M%	22.15		29.02		22.62		22.62
Wet Density (pcf)	Dw	128.73		121.94		128.32		128.78
Dry Density (pcf)	Dd	105.38		94.51		104.65		105.03

#	Day	Hrs.	Min.	Time Change t (sec.)	In Burette Reading	In Change / Out Change	Out Burette Reading	Burette Change (In-Out)	Air Head (psi)	Total Head h (cm)	Hydraulic Gradient	Hydraulic Conductivity k(cm/sec)
		9	41	0	101.2	0.0	5.8	95.4		95.4	13	
1.		13	44	14580	101.2	0.3	6.1	95.1		95.1	13	2.17e-8
		13	48	0	101.2	0.1	6.0	95.2	3	306.1	40	
2.		17	7	11940	101.1	0.2	6.2	94.9	3	305.8	40	6.88e-9
		17	7	0	101.1	0.3	6.2	94.9	3	305.8	40	
3.	1	8	8	54060	100.8	0.5	6.7	94.1	3	305.0	40	4.87e-9
		8	8	0	100.8	0.6	6.7	94.1	3	305.0	40	
4.		15	4	24960	100.2	1.1	7.8	92.4	3	303.3	40	2.25e-8
5.												
6.												
7.												
8.												
9.												
10.												

NOTES: ASTM D-5084

Gradient Range (high) 40 (low) 13

AVERAGE PERMEABILITY: 1.4e-8

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TRIAXIAL PERMEABILITY

QUALITY CONTROL CHECK

Client Name: MILLARD COUNTY, UTAH Project: ; No. 945013.00

Sample I.D.: B-2 @ 43.0' Soil Description:

MOISTURE DATA	Before Test		After Test			TEST DATA	
	Specimen	Trimmings	Specimen	Washings	Total		
Tare + Wet Soil Wt. (gm):		56.36	282.50			Specific Gravity	2.70
Tare + Dry Soil Wt. (gm):		43.72	231.60	107.40		Chamber Pressure (psi)	85.00
Moisture Loss Wt. (gm):		12.64	50.90			Back Pressure (psi)	60.00
Tare Weight (gm):		8.62	106.20	107.30		Eff. Consol Press. (psi)	25.00
Wet Soil Weight (gm):	176.50	47.74	176.30		176.44	Burette Area (cm2)	0.5027
Dry Soil Weight (gm):	125.50	35.10	125.40	0.10	125.50	C Factor (Final)	0.07080
Moisture Content (%):	40.64	36.01	40.59		40.59	"B" Check	0.94

SPECIMEN DATA		Initial	Change	Saturated	Change	Consolidated	Change	Final
Sample Length (in.)		2.089				2.065		2.065
Sample Diameter (in.)		1.922				1.915		1.917
Sample Length (cm)		5.31				5.25		5.25
Sample Diameter (cm)		4.88				4.86		4.87
Sample Area (cm2)		18.72				18.57		18.62
Dial Reading (cm)								
Burette Reading (cm)				66.50	9.00	75.50		
Solids Weight (cc)	Ws	125.50		125.50		125.50		125.50
Volume Total (cc)	Vt	99.32	7.10	106.42	9.00	97.42	0.25	97.67
Volume Solids (cc)	Vs	46.48		46.48		46.48		46.48
Volume Voids (cc)	Vv	52.84		59.94		50.94		51.19
Volume Water (cc)	Vw	51.00		59.94		50.94		50.94
Void Ratio	e	1.137		1.290		1.096		1.101
Saturation (%)	S	96.52		100.00		100.00		99.52
Porosity (%)	n	53.18		56.30		52.27		52.39
Moisture Content (%)	M%	40.64		47.76		40.59		40.59
Wet Density (pcf)	Dw	110.94		108.78		113.07		112.78
Dry Density (pcf)	Dd	78.89		73.62		80.42		80.22

#	Day	Hrs.	Min.	Time Change t (sec.)	In Burette Reading	In Change / Out Change	Out Burette Reading	Burette Change (In-Out)	Air Head (psi)	Total Head h (cm)	Hydraulic Gradient	Hydraulic Conductivity k(cm/sec)
1.		9	28	0	100.4	0.5	2.3	98.1		98.1	19	
		13	38	15000	100.0	0.6	2.9	97.1		97.1	19	5.08e-8
2.		13	42	0	99.9	1.1	2.9	97.0	2	237.6	45	
		17	7	12300	98.8	1.1	4.0	94.8	2	235.4	45	5.35e-8
3.		17	7	0	98.8	4.9	4.0	94.8	2	235.4	45	
	1	8	7	54000	93.9	4.7	8.7	85.2	2	225.8	43	5.46e-8
4.		8	7	0	93.9	1.2	8.7	85.2	2	225.8	43	
		12	4	14220	92.7	1.3	10.0	82.7	2	223.3	43	5.54e-8
5.		12	4	0	92.7	1.2	10.0	82.7	2	223.3	43	
		15	57	13980	91.5	1.1	11.1	80.4	2	221.0	42	5.24e-8
6.												
7.												
8.												
9.												
10.												

NOTES: ASTM D-5084

Gradient Range (high) 45 (low) 19

AVERAGE PERMEABILITY: 5.3e-8

APPENDIX C
Calculations of Soil and Waste Parameters for HELP II Modelling

CALCULATIONS FOR SOIL PARAMETERS - B-1 @ 32.5' (clayey silt - ML)

DRY UNIT WEIGHT = 110.56 lbs/ft³
MOIST UNIT WEIGHT = 126.76 lbs/ft³
SPECIFIC GRAVITY OF SOIL MINERALS = 2.70
SPECIFIC GRAVITY OF WATER = 1
UNIT WEIGHT OF WATER = 62.4 lbs/ft³

for one (1) cubic foot:
MOISTURE CONTENT (WT/WT) = 14.66%
WEIGHT WATER (Ww) = 16.2 lbs
WEIGHT SOIL (Ws) = 110.56 lbs

γ = unit weight (moist)
W = weight (soil, water, air)
V = volume (soil, water, air)
w = water
s = solid (soil)
a = air
t = total
G_s = specific gravity

$$\gamma_w = \frac{W_w}{V_w} \qquad V_w = \frac{W_w}{\gamma_w} = \frac{16.2\ lbs}{62.4\ \frac{lbs}{ft^3}} = 0.2596\ ft^3\ of\ H_2O$$

$$\gamma_s = G_s(\gamma_w) = 2.70(62.4\ \frac{lbs}{ft^3}) = 168.5\ \frac{lbs}{ft^3}$$

$$\gamma_s = \frac{W_s}{V_s} \qquad V_s = \frac{W_s}{\gamma_s} = \frac{110.56\ lbs}{168.5\ \frac{lbs}{ft^3}} = 0.6561\ ft^3\ of\ soil$$

$$V_{total} = V_{soil} + V_{water} + V_{air}$$

$$V_{air} = V_{total} - (V_{soil} + V_{water})$$

$$V_{air} = 1\ ft^3 - (0.6561\ ft^3 + 0.2596\ ft^3) = 0.0843\ ft^3$$

$$POROSITY\ (n,VOL/VOL) = \frac{V_w + V_a}{V_t} = \frac{0.2596 + 0.0843}{1} = 0.3439\frac{vol}{vol}$$

$$INITIAL\ SOIL\ WATER\ CONTENT\ (VOL/VOL) = \frac{V_w}{V_t} = \frac{0.2596}{1} = 0.2596\frac{vol}{vol}$$

$$HYDRAULIC\ CONDUCTIVITY = 6.4x10^{-9}\ \frac{cm}{sec}$$

CALCULATIONS FOR SOIL PARAMETERS - B-1 @ 53.0' (fat clay - CH or OL)

DRY UNIT WEIGHT = 105.38 lbs/ft³
MOIST UNIT WEIGHT = 128.73 lbs/ft³
SPECIFIC GRAVITY OF SOIL MINERALS = 2.70
SPECIFIC GRAVITY OF WATER = 1
UNIT WEIGHT OF WATER = 62.4 lbs/ft³

for one (1) cubic foot:
MOISTURE CONTENT (WT/WT) = 22.15%
WEIGHT WATER (Ww) = 23.35 lbs
WEIGHT SOIL (Ws) = 105.38 lbs

γ = unit weight (moist)
W = weight (soil, water, air)
V = volume (soil, water, air)
w = water
s = solid (soil)
a = air
t = total
G_s = specific gravity

$$\gamma_w = \frac{W_w}{V_w} \qquad V_w = \frac{W_w}{\gamma_w} = \frac{23.35\ lbs}{62.4\ \frac{lbs}{ft^3}} = 0.3742\ ft^3\ of\ H_2O$$

$$\gamma_s = G_s(\gamma_w) = 2.70(62.4\ \frac{lbs}{ft^3}) = 168.5\ \frac{lbs}{ft^3}$$

$$\gamma_s = \frac{W_s}{V_s} \qquad V_s = \frac{W_s}{\gamma_s} = \frac{105.38\ lbs}{168.5\ \frac{lbs}{ft^3}} = 0.6254\ ft^3\ of\ soil$$

$$V_{total} = V_{soil} + V_{water} + V_{air}$$

$$V_{air} = V_{total} - (V_{soil} + V_{water})$$

$$V_{air} = 1\ ft^3 - (0.6254\ ft^3 + 0.3742\ ft^3) = 0.0004\ ft^3$$

$$POROSITY\ (n,VOL/VOL) = \frac{V_w + V_a}{V_t} = \frac{0.3742 + 0.0004}{1} = 0.3746\frac{vol}{vol}$$

$$INITIAL\ SOIL\ WATER\ CONTENT\ (VOL/VOL) = \frac{V_w}{V_t} = \frac{0.3742}{1} = 0.3742\frac{vol}{vol}$$

$$HYDRAULIC\ CONDUCTIVITY = 1.4x10^{-8}\ \frac{cm}{sec}$$

CALCULATIONS FOR SOIL PARAMETERS - B-2 @ 43.0' (fat clay - CH or OL)

DRY UNIT WEIGHT = 78.89 lbs/ft³
MOIST UNIT WEIGHT = 110.94 lbs/ft³
SPECIFIC GRAVITY OF SOIL MINERALS = 2.70
SPECIFIC GRAVITY OF WATER = 1
UNIT WEIGHT OF WATER = 62.4 lbs/ft³

for one (1) cubic foot:
MOISTURE CONTENT (WT/WT) = 40.64%
WEIGHT WATER (Ww) = 32.05 lbs
WEIGHT SOIL (Ws) = 78.89 lbs

γ = unit weight (moist)
W = weight (soil, water, air)
V = volume (soil, water, air)
w = water
s = solid (soil)
a = air
t = total
G_s = specific gravity

$$\gamma_w = \frac{W_w}{V_w} \qquad V_w = \frac{W_w}{\gamma_w} = \frac{32.05\ lbs}{62.4\ \frac{lbs}{ft^3}} = 0.5136\ ft^3\ of\ H_2O$$

$$\gamma_s = G_s(\gamma_w) = 2.70(62.4\ \frac{lbs}{ft^3}) = 168.5\ \frac{lbs}{ft^3}$$

$$\gamma_s = \frac{W_s}{V_s} \qquad V_s = \frac{W_s}{\gamma_s} = \frac{78.89\ lbs}{168.5\ \frac{lbs}{ft^3}} = 0.4682\ ft^3\ of\ soil$$

$$V_{total} = V_{soil} + V_{water} + V_{air}$$

$$V_{air} = V_{total} - (V_{soil} + V_{water})$$

$$V_{air} = 1\ ft^3 - (0.4682\ ft^3 + 0.5136\ ft^3) = 0.0182\ ft^3$$

$$POROSITY\ (n,VOL/VOL) = \frac{V_w + V_a}{V_t} = \frac{0.5136 + 0.0182}{1} = 0.5318\frac{vol}{vol}$$

$$INITIAL\ SOIL\ WATER\ CONTENT\ (VOL/VOL) = \frac{V_w}{V_t} = \frac{0.5136}{1} = 0.5136\frac{vol}{vol}$$

$$HYDRAULICCONDUCTIVITY = 5.3x10^{-8}\ \frac{cm}{sec}$$

AVERAGE SOIL PARAMETERS

SAMPLE	*POROSITY*	*ISWC (vol/vol)*	*HYDR. CONDUCTIVITY*
B-1 @ 32.5'	0.3439	0.2596	6.4×10^{-9} cm/sec
B-1 @ 53.0'	0.3746	0.3742	1.4×10^{-6} cm/sec
B-2 @ 43.0'	0.5318	0.5136	5.3×10^{-6} cm/sec
AVERAGES	0.4167	0.3825	2.4×10^{-6} cm/sec

CALCULATIONS FOR WASTE PARAMETERS

DRY UNIT WEIGHT = 802.71 lbs/yd³ (29.73 lbs/ft³)
MOIST UNIT WEIGHT = 1000 lbs/yd³ (37.04 lbs/ft³)
SPECIFIC GRAVITY OF DRY WASTE = 1.29
SPECIFIC GRAVITY OF WATER = 1
UNIT WEIGHT OF WATER = 62.4 lbs/ft³

for one (1) cubic foot:
MOISTURE CONTENT (WT/WT) = 29.82%
WEIGHT WATER (Ww) = 8.51 lbs
WEIGHT WASTE (Ws) = 28.53 lbs

γ = unit weight
W = weight
V = volume
w = water
s = solid (waste)
a = air
t = total
G_s = specific gravity

$$\gamma_w = \frac{W_w}{V_w} \qquad V_w = \frac{W_w}{\gamma_w} = \frac{8.51\ lbs}{62.4\ \frac{lbs}{ft^3}} = 0.1364\ ft^3\ of\ H_2O$$

$$\gamma_s = G_s(\gamma_w) = 1.29(62.4\ \frac{lbs}{ft^3}) = 80.49\ \frac{lbs}{ft^3}$$

$$\gamma_s = \frac{W_s}{V_s} \qquad V_s = \frac{W_s}{\gamma_s} = \frac{28.53\ lbs}{80.49\ \frac{lbs}{ft^3}} = 0.3545\ ft^3\ of\ soil$$

$$V_{total} = V_{soil} + V_{water} + V_{air}$$

$$V_{air} = V_{total} - (V_{soil} + V_{water})$$

$$V_{air} = 1\ ft^3 - (0.3545\ ft^3 + 0.1364\ ft^3) = 0.5091\ ft^3$$

$$POROSITY\ (n, VOL/VOL) = \frac{V_w + V_a}{V_t} = \frac{0.1364 + 0.5091}{1} = 0.6455\frac{vol}{vol}$$

$$INITIAL\ WASTE\ WATER\ CONTENT\ (VOL/VOL) = \frac{V_w}{V_t} = \frac{0.1364}{1} = 0.1364\frac{vol}{vol}$$

Winnemucca Regional Landfill - Aggregate Moisture Contents			
Waste Type	Percent of Waste Stream (a)	Moisture Content (b)	Percent Moisture (Wt/Wt)(c)
Paper			
Corrugated	19.57	0.10	1.96
Mixed	16.81	0.08	1.34
Newspaper	1.22	0.08	0.10
High Grade	0.83	0.08	0.07
Other	0.00	0.08	0.00
Plastic			
HDPE	3.13	0.04	0.13
PET	0.15	0.04	0.01
Film	4.20	0.04	0.17
Other	1.96	0.06	0.12
Glass			
Refillable	0.00	0.04	0.00
Redemption	3.58	0.04	0.14
Other Recyclable	2.03	0.04	0.08
Non-Recyclable	0.00	0.04	0.00
Metals			
Aluminum Cans	1.53	0.04	0.06
Bi-Metals	0.00	0.04	0.00
Ferrous/Tin	1.77	0.04	0.07
Non-Ferrous	0.00	0.04	0.00
White Goods	9.92	0.02	0.20
Yard Waste	4.13	0.80	3.30
Other Organics			
Food Waste	27.29	0.80	21.83
Tires/Rubber	0.00	0.04	0.00
Wood Wastes	0.00	0.40	0.00
Ag. Crop Residues	0.00	0.90	0.00
Manure	0.00	0.90	0.00
Textiles/Leather	1.43	0.15	0.21
Other Waste			
Inert Solids	0.00	0.15	0.00
Household Hazardous Wastes	0.30	0.10	0.03
Infectious Wastes	0.15	0.03	0.00
Special Wastes			
Ash	0.00	0.12	0.00
Sewage Sludge	0.00	0.90	0.00
Industrial Sludge	0.00	0.90	0.00
Asbestos	0.00	0.10	0.00
Auto Shred Parts	0.00	0.10	0.00
Auto Bodies	0.00	0.10	0.00
Other Special	0.00	0.30	0.00
TOTAL MOISTURE CONTENT (%)			29.82

(a) from Vector (1991)

(b) Moisture content data from Tchobanoglous, et. al., (1977)

(c) calculated

Winnemucca Regional Landfill - Specific Gravity of Waste Aggregate			
Waste Type	Percent of Waste Stream (a)	Specific Gravity (b)	Contribution to Total (c)
Paper			
Corrugated	19.57	0.50	0.10
Mixed	16.81	0.50	0.08
Newspaper	1.22	0.50	0.01
High Grade	0.83	0.50	0.00
Other	0.00	0.50	0.00
Plastic			
HDPE	3.13	1.00	0.03
PET	0.15	1.00	0.00
Film	4.20	1.00	0.04
Other	1.96	1.00	0.02
Glass			
Refillable	0.00	2.10	0.00
Redemption	3.58	2.10	0.08
Other Recyclable	2.03	2.10	0.04
Non-Recyclable	0.00	2.10	0.00
Metals			
Aluminum Cans	1.53	5.30	0.08
Bi-Metals	0.00	5.30	0.00
Ferrous/Tin	1.77	5.30	0.09
Non-Ferrous	0.00	5.30	0.00
White Goods	9.92	5.30	0.53
Yard Waste	4.13	0.50	0.02
Other Organics			
Food Waste	27.29	0.50	0.14
Tires/Rubber	0.00	1.00	0.00
Wood Wastes	0.00	0.50	0.00
Ag. Crop Residues	0.00	0.50	0.00
Manure	0.00	0.50	0.00
Textiles/Leather	1.43	1.40	0.02
Other Waste			
Inert Solids	0.00	2.00	0.00
Household Hazardous Wastes	0.30	1.50	0.00
Infectious Wastes	0.15	1.00	0.00
Special Wastes			
Ash	0.00	---	0.00
Sewage Sludge	0.00	---	0.00
Industrial Sludge	0.00	---	0.00
Asbestos	0.00	---	0.00
Auto Shred Parts	0.00	---	0.00
Auto Bodies	0.00	---	0.00
Other Special	0.00	---	0.00
CALCULATED SPECIFIC GRAVITY			1.29

(a) from Vector (1991)

(b) specific gravity data from Perry's Chemical Engineer's Handbook (1984)

(c) calculated

APPENDIX D
Output Files from HELP Model Simulations

HELP Model Output:

RUN 1

MONTHLY TOTALS FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.25	0.46	0.84	0.87	0.14	0.34
	0.01	0.67	1.35	0.54	0.80	0.50
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.015	0.400	1.010	0.697	0.219	0.207
(INCHES)	0.187	0.421	1.649	0.091	0.541	0.588
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	6.77	20310.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	7.026	21078.	103.78
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.256	-768.	-3.78
SOIL WATER AT START OF YEAR	41.48	124434.	
SOIL WATER AT END OF YEAR	41.22	123666.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.78	0.11	0.87	1.01	1.36	0.00
	0.41	0.34	0.12	0.23	0.52	1.35
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.547	0.312	0.840	0.924	1.477	0.613
(INCHES)	0.342	0.263	0.205	0.189	0.160	0.567
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	7.10	21300.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	6.439	19316.	90.68
PERCOLATION FROM LAYER 10	0.0001	0.	0.00

PEAK DAILY VALUES FOR YEARS 1 THROUGH 2

	(INCHES)	(CU. FT.)
PRECIPITATION	0.53	1590.0
RUNOFF	0.000	0.0
PERCOLATION FROM LAYER 10	0.0000	0.0
SNOW WATER	0.72	2158.7

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.1455

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0785

FINAL WATER STORAGE AT END OF YEAR 2

LAYER	(INCHES)	(VOL/VOL)
1	1.82	0.1518
2	6.67	0.1390
3	1.53	0.1271
4	6.77	0.1410
5	1.53	0.1271
6	6.77	0.1410
7	1.53	0.1271
8	6.77	0.1410
9	1.53	0.1271
10	6.77	0.1410
SNOW WATER	0.21	

MILLARD COUNTY LANDFILL
RUN 1 - 2 YEARS (SOIL TEXTURE #5 - SILTY SAND; WASTE #18 w/adjusted M_c)
OCTOBER 24, 1994

BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0001999999995 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0001999999995 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0001999999995 CM/SEC

HELP Model Output:

RUN 2

MILLARD COUNTY LANDFILL
RUN 2 - 20 YEARS (SOIL TEXTURE #5 - SILTY SAND; WASTE #18 w/adjusted M_c)
OCTOBER 24, 1994

BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER
THICKNESS = 12.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1309 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER
THICKNESS = 48.00 INCHES
POROSITY = 0.5200 VOL/VOL
FIELD CAPACITY = 0.2942 VOL/VOL
WILTING POINT = 0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000199999995 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER
THICKNESS = 12.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1309 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER
THICKNESS = 48.00 INCHES
POROSITY = 0.5200 VOL/VOL
FIELD CAPACITY = 0.2942 VOL/VOL
WILTING POINT = 0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000199999995 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER
THICKNESS = 12.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1309 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER
THICKNESS = 48.00 INCHES
POROSITY = 0.5200 VOL/VOL
FIELD CAPACITY = 0.2942 VOL/VOL
WILTING POINT = 0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000199999995 CM/SEC

LAYER 7

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 8

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 9

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 10

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	83.31
TOTAL AREA OF COVER	=	36000. SQ FT
EVAPORATIVE ZONE DEPTH	=	16.00 INCHES
POTENTIAL RUNOFF FRACTION	=	0.000000
UPPER LIMIT VEG. STORAGE	=	7.5640 INCHES
INITIAL VEG. STORAGE	=	2.1312 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	41.4780 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR MILFORD UTAH

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.00	32.70	39.70	47.80	57.60	67.50
75.70	73.40	63.30	51.00	37.40	27.70

MONTHLY TOTALS FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.25	0.46	0.84	0.87	0.14	0.34
	0.01	0.67	1.35	0.54	0.80	0.50
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.015	0.400	1.010	0.697	0.219	0.207
(INCHES)	0.187	0.421	1.649	0.091	0.541	0.588
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	6.77	20310.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	7.026	21078.	103.78
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.256	-768.	-3.78
SOIL WATER AT START OF YEAR	41.48	124434.	
SOIL WATER AT END OF YEAR	41.22	123666.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.78	0.11	0.87	1.01	1.36	0.00
	0.41	0.34	0.12	0.23	0.52	1.35
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.547	0.312	0.840	0.924	1.477	0.613
(INCHES)	0.342	0.263	0.205	0.189	0.160	0.567
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	7.10	21300.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	6.439	19316.	90.68
PERCOLATION FROM LAYER 10	0.0001	0.	0.00

CHANGE IN WATER STORAGE	0.661	1984.	9.31
SOIL WATER AT START OF YEAR	41.22	123666.	
SOIL WATER AT END OF YEAR	41.67	125021.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.21	629.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	1.67	1.31	0.71	0.14	1.45	0.92
	0.01	0.66	0.85	0.39	0.08	0.78
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.166	1.660	1.090	0.347	1.453	0.696
(INCHES)	0.260	0.233	1.436	0.378	0.307	0.376
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 3

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	8.97	26910.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	9.402	28207.	104.82
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.433	-1298.	-4.82
SOIL WATER AT START OF YEAR	41.67	125021.	
SOIL WATER AT END OF YEAR	41.34	124016.	
SNOW WATER AT START OF YEAR	0.21	629.	
SNOW WATER AT END OF YEAR	0.11	337.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.38	0.41	0.77	0.75	0.45	0.51
	0.17	0.60	0.02	0.38	0.31	0.22
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.276	0.166	1.145	0.409	0.279	0.490
(INCHES)	0.395	1.037	0.409	0.285	0.257	0.214
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 4

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	4.97	14910.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	5.359	16078.	107.83
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.389	-1168.	-7.83
SOIL WATER AT START OF YEAR	41.34	124016.	
SOIL WATER AT END OF YEAR	41.06	123185.	
SNOW WATER AT START OF YEAR	0.11	337.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.42	0.58	0.86	1.09	0.16	0.05
	0.60	0.48	0.38	0.00	0.42	1.45
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.335	0.153	0.927	1.304	0.417	0.265
	0.232	0.202	0.173	0.155	0.159	0.394
PERCOLATION FROM LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 5

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	6.49	19470.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	4.716	14147.	72.66
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	1.774	5322.	27.34
SOIL WATER AT START OF YEAR	41.06	123185.	
SOIL WATER AT END OF YEAR	42.48	127445.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.35	1062.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.52	0.90	1.13	1.11	1.88	0.80
	1.11	1.02	0.00	0.48	0.15	1.26
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.456	1.013	1.066	1.300	1.786	0.625
(INCHES)	1.214	1.265	0.461	0.293	0.228	0.360
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 6

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	10.36	31080.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	11.067	33202.	106.83
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.707	-2122.	-6.83
SOIL WATER AT START OF YEAR	42.48	127445.	
SOIL WATER AT END OF YEAR	42.12	126348.	
SNOW WATER AT START OF YEAR	0.35	1062.	
SNOW WATER AT END OF YEAR	0.01	37.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.58	0.71	0.91	2.18	0.43	0.68
	0.66	0.21	0.33	2.21	1.37	0.77
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.763	0.674	1.273	1.626	0.942	0.621
(INCHES)	0.443	0.222	0.387	2.441	0.739	1.077
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 7

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	11.04	33120.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	11.208	33624.	101.52
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.168	-504.	-1.52
SOIL WATER AT START OF YEAR	42.12	126348.	

SOIL WATER AT END OF YEAR	41.96	125880.
SNOW WATER AT START OF YEAR	0.01	37.
SNOW WATER AT END OF YEAR	0.00	0.
ANNUAL WATER BUDGET BALANCE	0.00	0. 0.00

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MONTHLY TOTALS FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.41	0.53	0.79	1.24	0.15	1.22
	0.12	0.51	0.59	0.81	1.34	1.35
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.550	0.329	0.859	1.234	0.318	1.116
	0.510	0.312	0.245	1.401	0.658	1.123
PERCOLATION FROM LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 8

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	9.06	27180.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	8.657	25970.	95.55
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.403	1210.	4.45
SOIL WATER AT START OF YEAR	41.96	125880.	
SOIL WATER AT END OF YEAR	42.36	127090.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.16	0.57	0.53	0.24	0.00	0.54
	0.19	0.74	0.11	1.05	0.37	1.09
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.952	0.338	0.416	0.214	0.188	0.388
	0.164	0.559	0.137	0.673	0.993	1.047
PERCOLATION FROM LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 9

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	5.59	16770.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	6.070	18210.	108.58
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.480	-1440.	-8.59
SOIL WATER AT START OF YEAR	42.36	127090.	
SOIL WATER AT END OF YEAR	41.88	125650.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.76	0.37	0.61	0.56	0.59	0.25
	1.10	0.19	1.41	0.67	1.39	0.36
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.964	0.436	0.407	0.398	0.895	0.496
(INCHES)	0.627	0.242	0.708	1.179	0.709	1.242
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	8.26	24780.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	8.303	24909.	100.52
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.043	-129.	-0.52
SOIL WATER AT START OF YEAR	41.88	125650.	
SOIL WATER AT END OF YEAR	41.84	125521.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	1.38	0.86	0.50	0.03	0.54	0.71
	0.17	0.53	0.62	0.22	0.72	0.25
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.849	1.031	0.507	0.258	0.486	0.760
(INCHES)	0.181	0.457	0.633	0.588	0.304	0.225
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 11

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	6.53	19590.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	6.280	18841.	96.18
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.250	749.	3.82
SOIL WATER AT START OF YEAR	41.84	125521.	
SOIL WATER AT END OF YEAR	42.09	126270.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.10	0.70	0.29	0.98	1.70	0.97
	0.44	0.34	0.96	0.00	1.68	0.72
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.163	0.768	0.370	0.832	1.841	0.793
(INCHES)	0.658	0.230	0.583	0.910	0.995	0.549
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 12

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	8.88	26640.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	8.693	26077.	97.89
PERCOLATION FROM LAYER 10	0.0001	0.	0.00

CHANGE IN WATER STORAGE	0.187	562.	2.11
SOIL WATER AT START OF YEAR	42.09	126270.	
SOIL WATER AT END OF YEAR	42.01	126025.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.27	807.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	1.60	0.81	1.29	0.57	0.58	0.35
	0.75	0.68	1.23	0.35	0.63	0.12
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	1.139	1.347	0.926	0.805	0.515	0.490
(INCHES)	0.566	0.541	1.465	0.519	0.370	0.236
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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ANNUAL TOTALS FOR YEAR 13

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	8.96	26880.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	8.920	26760.	99.55
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.040	120.	0.45
SOIL WATER AT START OF YEAR	42.01	126025.	
SOIL WATER AT END OF YEAR	42.32	126952.	
SNOW WATER AT START OF YEAR	0.27	807.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.77	0.59	0.62	0.38	0.41	0.17
	0.54	0.04	0.18	0.77	0.20	0.40
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.445	1.033	0.385	0.261	0.411	0.185
(INCHES)	0.535	0.157	0.145	0.878	0.521	0.290
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 14

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	5.07	15210.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	5.246	15737.	103.46
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	-0.176	-527.	-3.47
SOIL WATER AT START OF YEAR	42.32	126952.	
SOIL WATER AT END OF YEAR	42.14	126425.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.86	0.36	0.10	0.24	0.41	0.67
	0.05	1.62	1.19	0.70	0.16	0.98
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.379	0.798	0.390	0.268	0.223	0.193
	0.174	1.566	0.991	1.131	0.316	0.358
PERCOLATION FROM LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 15

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	7.34	22020.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	6.788	20364.	92.48
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.552	1655.	7.52
SOIL WATER AT START OF YEAR	42.14	126425.	
SOIL WATER AT END OF YEAR	42.32	126953.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.38	1128.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.38	0.69	0.99	0.87	0.00	0.04
	0.04	0.97	0.72	0.90	0.57	1.03
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.238	1.221	0.979	0.659	0.299	0.227
(INCHES)	0.202	0.496	1.052	0.402	0.501	0.911
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 16

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	7.20	21600.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	7.189	21568.	99.85
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.011	32.	0.15
SOIL WATER AT START OF YEAR	42.32	126953.	
SOIL WATER AT END OF YEAR	42.67	128019.	
SNOW WATER AT START OF YEAR	0.38	1128.	
SNOW WATER AT END OF YEAR	0.03	93.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.13	0.94	1.63	0.72	1.48	0.00
	1.64	0.66	0.00	1.67	0.73	0.48
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.662	0.536	1.688	0.643	1.458	0.354
(INCHES)	1.328	0.582	0.183	1.448	0.594	0.711
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 17

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	10.08	30240.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	10.188	30563.	101.07
PERCOLATION FROM LAYER 10	0.0001	0.	0.00

CHANGE IN WATER STORAGE	-0.108	-324.	-1.07
SOIL WATER AT START OF YEAR	42.67	128019.	
SOIL WATER AT END OF YEAR	42.58	127733.	
SNOW WATER AT START OF YEAR	0.03	93.	
SNOW WATER AT END OF YEAR	0.02	56.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.38	0.86	0.95	0.29	2.05	0.44
	0.40	0.85	1.39	1.03	0.41	0.46
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.393	0.941	1.132	0.464	1.738	0.367
	0.277	0.529	1.192	1.709	0.333	0.317
PERCOLATION FROM LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 18

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	9.51	28530.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	9.392	28175.	98.76
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.118	355.	1.24
SOIL WATER AT START OF YEAR	42.58	127733.	
SOIL WATER AT END OF YEAR	42.71	128144.	
SNOW WATER AT START OF YEAR	0.02	56.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.33	0.24	0.82	0.39	0.13	0.64
	0.11	0.00	0.48	0.05	0.07	0.52
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.316	0.196	0.996	0.519	0.300	0.231
	0.203	0.175	0.168	0.149	0.136	0.200
PERCOLATION FROM LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 19

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	3.78	11340.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	3.590	10769.	94.96
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.190	571.	5.03
SOIL WATER AT START OF YEAR	42.71	128144.	
SOIL WATER AT END OF YEAR	42.90	128715.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION(INCHES)	0.10	0.61	1.07	0.06	0.41	0.56
	0.00	0.38	0.20	0.10	0.70	1.19
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.132	0.748	1.547	0.375	0.264	0.217
(INCHES)	0.188	0.186	0.153	0.145	0.265	0.757
PERCOLATION FROM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10 (INCHES)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ANNUAL TOTALS FOR YEAR 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	5.38	16140.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	4.976	14928.	92.49
PERCOLATION FROM LAYER 10	0.0001	0.	0.00
CHANGE IN WATER STORAGE	0.404	1212.	7.51
SOIL WATER AT START OF YEAR	42.90	128715.	
SOIL WATER AT END OF YEAR	42.99	128976.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.32	951.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.60	0.63	0.81	0.69	0.72	0.49
	0.43	0.57	0.61	0.63	0.63	0.76
STD. DEVIATIONS	0.47	0.28	0.34	0.51	0.67	0.35
	0.45	0.37	0.50	0.56	0.48	0.42
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.637	0.705	0.898	0.677	0.776	0.467
	0.434	0.484	0.619	0.748	0.454	0.577
STD. DEVIATIONS	0.381	0.426	0.386	0.413	0.611	0.252
	0.330	0.385	0.503	0.635	0.261	0.341
PERCOLATION FROM LAYER 10						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	7.57	(2.021)	22701.	100.00
RUNOFF	0.000	(0.000)	0.	0.00
EVAPOTRANSPIRATION	7.475	(2.187)	22426.	98.79
PERCOLATION FROM LAYER 10	0.0001	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.092	(0.533)	275.	1.21

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	1.19	3570.0
RUNOFF	0.000	0.0
PERCOLATION FROM LAYER 10	0.0000	0.0
SNOW WATER	1.14	3427.3
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2028	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0785	

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.04	0.1700
2	7.77	0.1618
3	1.37	0.1138
4	6.94	0.1445
5	1.36	0.1135
6	6.93	0.1445
7	1.36	0.1135
8	6.93	0.1445
9	1.36	0.1135
10	6.93	0.1445
SNOW WATER	0.32	

HELP Model Output:

RUN 3

MILLARD COUNTY LANDFILL
RUN 3 - 20 YEARS w/bottom barrier soil liner
OCTOBER 25, 1994

BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 7

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 8

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 9

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 10

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 11

BARRIER SOIL LINER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4167 VOL/VOL
FIELD CAPACITY	=	0.3100 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4167 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000024000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	83.31
TOTAL AREA OF COVER	=	36000. SQ FT
EVAPORATIVE ZONE DEPTH	=	16.00 INCHES
POTENTIAL RUNOFF FRACTION	=	0.000000
UPPER LIMIT VEG. STORAGE	=	7.5640 INCHES
INITIAL VEG. STORAGE	=	2.1312 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	46.4784 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR MILFORD UTAH

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.00	32.70	39.70	47.80	57.60	67.50
75.70	73.40	63.30	51.00	37.40	27.70

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.60	0.63	0.81	0.69	0.72	0.49
	0.43	0.57	0.61	0.63	0.63	0.76
STD. DEVIATIONS	0.47	0.28	0.34	0.51	0.67	0.35
	0.45	0.37	0.50	0.56	0.48	0.42
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.637	0.705	0.898	0.677	0.776	0.467
	0.434	0.484	0.619	0.748	0.454	0.577
STD. DEVIATIONS	0.381	0.426	0.386	0.413	0.611	0.252
	0.330	0.385	0.503	0.635	0.261	0.341
PERCOLATION FROM LAYER 11						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	7.57	(2.021)	22701.	100.00
RUNOFF	0.000	(0.000)	0.	0.00
EVAPOTRANSPIRATION	7.475	(2.187)	22426.	98.79
PERCOLATION FROM LAYER 11	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.092	(0.533)	275.	1.21

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	1.19	3570.0
RUNOFF	0.000	0.0
PERCOLATION FROM LAYER 11	0.0000	0.0
HEAD ON LAYER 11	0.0	
SNOW WATER	1.14	3427.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2028

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0785

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.04	0.1700
2	7.77	0.1618
3	1.37	0.1138
4	6.94	0.1445
5	1.36	0.1135
6	6.93	0.1445
7	1.36	0.1135
8	6.93	0.1445
9	1.36	0.1135
10	6.94	0.1445
11	5.00	0.4167
SNOW WATER	0.32	

Related Correspondence from UDEQ and Response to Request for Additional Information

Michael O. Leavitt
Governor
Dianne R. Nielson, Ph.D.
Executive Director
Dennis R. Downs
Director

State of Utah

DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF SOLID AND HAZARDOUS WASTE

288 North 1460 West
P.O. Box 144880
Salt Lake City, Utah 84114-4880
(801) 538-6170
(801) 538-6715 Fax
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December 12, 1994

Robyn R. Pearson
County Administrator
Millard County
PO Box 854
Delta, Utah 84624

Subject: Application for Wavier of Ground Water Monitoring and Liner Requirement at the Millard County Landfill

Dear Robyn:

The Application for Wavier of Ground Water Monitoring and Liner Requirements at the Millard County Landfill, received on November 10, 1994, has been reviewed and a Request for Additional Information is enclosed.

A written response to each of the points listed in the Request for Addition Information is expected. The responses should be completed with the understanding that when the determination is made that the application is complete, the responses can be incorporated into the application in their logical and proper places, to produce a complete and final application in one document.

Please contact me or Ralph Bohn at 801-538-6170, if you have questions or need further information.

Sincerely,

Carl E. Wadsworth

Carl E. Wadsworth, Environmental Scientist
Solid Waste Section

CEW/jch

c: Robert Resendes, M.B.A., M.T., Department Director, Central Utah Public Health Dept.
Roger Foisy, DEQ District Engineer
Douglas J. Martin, Director of Environmental Affairs, Vector Engineering, Inc.

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APPLICATION FOR WAIVER
from
GROUND WATER MONITORING AND LINER REQUIREMENTS

MILLARD COUNTY LANDFILL

REQUEST FOR ADDITIONAL INFORMATION
December 12, 1994

1. General: The Application for Waiver from Ground Water Monitoring and Liner Requirements at the Millard County Landfill is considered part of the application to operate the Millard County Landfill. The Application for Waiver contains much of the information requested for the geohydrological assessment section of the permit application. The applicable information as stipulated in Subsection R315-310-4(2)(b) of the *Utah Solid Waste Permitting and Management Rules* for a geohydrological assessment, which is not contained in the Application for Waiver, must be included with the rest of the permit application at the time it is submitted.

2. Occurrence and Depth of Ground Water: The statement "However, the closest well to the landfill which has recorded information . . ." in Subsection 8.1, page 5, appears to infer that there may be a well located closer to the landfill with no recorded information. Is there such a well? Also, several references are made to published information on wells as to the depth to ground water. Was the depth to ground water actually measured in any off-site wells? Were well logs from any of the off-site wells used to help document subsurface features?

3. Active Life of Landfill: Subsection 8.1, page 13, indicates that the active life of an average trench at the landfill is approximately two years and implies that a final cover will be placed on a trench as soon as it is filled. However, Subsection 8.4, page 14, states that a final cover will be installed at the end of the active life of the facility. Will each trench receive a final cover as it is filled or will the whole facility receive a final cover when all trenches are filled?

4. Maximum vs. Minimum: In its calculations, the HELP Model is designed to use 12 layers, or less, of waste and soil. Therefore, the word "minimum" of the statement in Subsection 9.1, page 14, "In order to . . . and stay within the 12 layer minimum of the program . . ." should be changed to "maximum."

5. Comparison of Hydraulic Conductivities: As presented in Subsection 9.2, pages 16 and 17, the default parameter of 1×10^{-3} cm/sec should be used in the HELP Model to approximate a conservative prediction of liquid movement through the layers of the landfill. However, the comparison of the default parameter for hydraulic conductivity to the hydraulic conductivity of the in-place soils at the site appears to be faulty. The

presentation infers that since the native soils, which have an in-place hydraulic conductivity approaching the range of 10^{-8} or 10^{-9} cm/sec, are used for the daily and intermediate cover layers, then these layers would also have the same range of hydraulic conductivity. Under normal landfill operations, there is a high probability that a hydraulic conductivity lower than the 1 x 10^{-3} cm/sec would be achieved when the excavated native soils are used as the daily and intermediate cover layers. There is no question that the increased potential of attaining a low hydraulic conductivity in these cover layers is a valuable benefit to the operation of the landfill. However, under the same normal landfill operating conditions, it would be virtually impossible to achieve the extremely low hydraulic conductivity values in the cover layers that may exist in the undisturbed native soils.

6. Lost Air Circulation: In the log of Boring B-1, Appendix A, air circulation was lost at a depth of approximately 73 feet. What was the reason for this loss of circulation? Should it effect the interpretation of any data?

7. Differences in Moisture Content Values: The moisture content of the soils and waste are given as follows:

	Laboratory Determined Values	Calculated Values
B-1	15%	26%
B-2	22%	37%
B-3	41%	51%
Waste	29%	14%

However, the moisture content values used in the HELP Model calculations were 13% for the soil layers and 14% for the waste layers. If the calculated value for the moisture content of the waste was used in the model calculations, why not also use the calculated values for the soil moisture content? Using lower values for moisture content than what may actually exist in the soil or the waste will artificially increase the potential storage capacity of these layers. This will cause the model to predict a decreased amount of leachate to percolate from the bottom of the landfill. Should the model calculations be done again using the higher moisture content values?

Millard Co. LF

Commissioner C. Frank Baker
Commissioner Lana Moon
Commissioner Tony Dearden

COURTHOUSE - FILLMORE
60 South Main
P.O. Box 226
Fillmore, Utah 84631

(801) 743-6223
Fax (801) 743-6923

Robyn R. Pearson
Millard County Administrator

COUNTY OFFICE - DELTA
71 South 200 West
P.O. Box 854
Delta, Utah 84624

(801) 864-2788
Fax (801) 864-2446

95-00146

January 10, 1995

CARL E. WADSWORTH, Environmental Scientist
DEPARTMENT OF ENVIRONMENTAL QUALITY
Division of Solid & Hazardous Waste
288 North 1460 West
P.O. Box 144880
Salt Lake City, UT 84114-4880

Dear Mr. Wadsworth:

Attached to this letter, please find our responses to your Request For Additional Information. I hope that we have properly thought through the responses and that they answer your questions in their entirety. If you have additional questions, please don't hesitate to contact me.

Sincerely,

ROBYN R. PEARSON
Millard County Landfill

RRP/sld

APPLICATION FOR A WAIVER
from
GROUND WATER MONITORING AND LINER REQUIREMENTS

MILLARD COUNTY LANDFILL

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
January 3, 1995

COMMENT #1

The Application for a Waiver from Ground Water Monitoring and Liner Requirements will be submitted as part of the permit application. The additional information required of a geohydrological assessment, which is not contained in the waiver application, will also be included in the permit application. This information will include the following:

- a discussion of faults, unstable slopes, and subsidence areas on site;
- a discussion on the quantity, location and construction of all private and public wells on the site and within a 2,000 foot radius of the site;
- a tabulation of all water rights for ground and surface water on the site and within a 2,000 foot radius of the site;
- the identification and description of all surface waters on the site and within a one-mile radius of the site; and,
- a discussion of background ground and surface water quality based on recorded data from nearby wells.

COMMENT #2

The section of the waiver application cited in comment #1 (Section 8.1) is incorrect. The correct section is Section 6.1. The well discussed in Section 6.1, on page 5 of the waiver application, is not the closest well to the landfill. This well was selected for discussion because it is collared at an elevation of 4726 feet, which is closer to the elevation of the landfill, and is located in a similar geologic position as the landfill, relative to the basin. This well is located approximately two miles north of the landfill. Due to the similarities in elevation and position relative to the basin, it is likely that depositional sequences and subsurface geology are similar for both locations, and that the corresponding ground water levels for this well are representative of ground water levels in the vicinity of the landfill. Static water level measurements from this well were used only to obtain a first approximation of the ground water level.

The well used in the WHPA modelling in Section 10.0 of the waiver application is the closest well to the landfill. This well is located approximately one mile southwest of the landfill boundary, and approximately 1.3 miles from the current active trench. The well is collared at an elevation of 4634 feet (MSL), which is between 50 and 70 feet lower than the surface elevation of the landfill property. This closest well is reportedly abandoned. A brief discussion of this well is included in Section 10.2, page 21, of the waiver application.

Ground water was not measured in any of the off-site wells during the development of the waiver application. Well logs from off-site wells were not used to document subsurface geology. During the course of this study, they were used as described above, , in the interpretation of ground water data, and to assist in the determination of WHPA model input parameters as discussed in Section 10.2 of the waiver application.

COMMENT #3

Currently, the material excavated from each trench is stockpiled over the previously active trench, forming a cover up to 15 feet thick in places. Future landfill operations will be similar. After the completion of each trench, a minimum of 12 inches of *interim* cover will be placed and compacted over the trench area. Based on the results of laboratory permeability tests on the subsurface soils, it is expected that the permeability of the compacted *interim* cover will approach the criteria for an 18-inch barrier layer component of final cover. Final thicknesses of interim cover may exceed 12 inches, but will not be less. Final cover will be applied at the end of the active life of the facility. The final cover will be installed in accordance with the provisions of UAC R315-303-4(4).

COMMENT #4

The word "minimum", used in Subsection 9.1, page 14, was used in error. The corrected sentence should read as follows:

> "In order to maintain this ratio and stay within the 12 layer maximum of the program, it was necessary to create waste and soil layers of exaggerated thickness."

COMMENT #5

Laboratory-derived values for hydraulic conductivity of the *in situ* native soils were reported as $6.4x10^{-9}$, $1.4x10^{-8}$, and $5.3x10^{-8}$ cm/sec. The default value used in the HELP model simulations for daily cover soil layers was $1x10^{-3}$ cm/sec. This default value represents much more permeable material than the laboratory derived values and is therefore more representative of excavated native material. The use of a more permeable value resulted in a higher, and therefore more conservative, predicted percolation from the base of the landfill.

COMMENT #6

The comment regarding "lost circulation" in the drill log of hole B-1 should not affect the interpretation of any data. The loss of circulation was a result of moist clay and silt which collected on the sides of the hole and the drill pipe. During drilling, the pathway from the bottom to the top of the hole was periodically cut off, which prevented the return of drill cuttings and air to the surface. The loss of circulation during drilling is not significant with respect to the interpretation of subsurface geology.

COMMENT #7

As described in Subsection 9.2 of the waiver application, HELP model default parameters were used for soil cover layers in the landfill simulation. Default soil #5, classified as a silty sand, was used as a conservative representation of excavated native materials, which are composed of silty clays and clayey silts. Default soil #5 has the following characteristics:

- porosity = 0.4570 vol/vol;
- field capacity = 0.1309 vol/vol;
- wilting point = 0.0580 vol/vol; and,
- saturated hydraulic conductivity = 0.001 cm/sec.

The HELP model considers any moisture in excess of wilting point to be free-draining. The use of the calculated initial moisture content of the soil (average of 0.3825 vol/vol) with the default soil field capacity (0.1309 vol/vol) simulates unrealistic free-draining conditions. The majority of the native soils beneath the site were visually classified in the field as only slightly moist. As a result, the calculated moisture content, in conjunction with default soil characteristics (field capacity, wilting point, and porosity) represents entirely different soil conditions than are observed in the field. In addition, the calculated average moisture content (0.3825 vol/vol) is approximately three times the field capacity of the default soil identified (0.1309 vol/vol).

If not set by the user, the HELP model automatically sets the initial moisture content equal to field capacity. This provision in the model allows for a conservative prediction of percolation since any moisture in excess of wilting point is free draining. According to this information, if the calculated initial moisture content is matched to a default field capacity in the HELP model, the corresponding soil is a high plasticity clay or liner soil. Based on the conservative provisions built into the HELP model, the use of the calculated moisture content in conjunction with default data for a high plasticity or liner clay will produce conservative results. In effect, when the initial moisture content of any soil used in the model is set equal to field capacity, the controlling factor over the amount of percolation exiting the bottom of the waste mass becomes the hydraulic conductivity of that soil. Since the model considers moisture in excess of field capacity to be free-draining, any moisture which enters the waste layers will pass through at a rate

controlled by the hydraulic conductivity. Accordingly, initial soil moisture content was set equal to the default field capacity. The controlling factor over fluid movement in the daily cover layers then becomes the hydraulic conductivity, which was $1x10^{-3}$ cm/sec, approximately five orders of magnitude more permeable than laboratory-derived values. This represents a conservative, free-draining condition in a much more permeable material than is actually used for daily cover.

A review of waste sort data from an analogous landfill in Winnemucca, Nevada, indicated that the in-place moisture content of waste in the Winnemucca Landfill was considerably less than the default field capacity used in the HELP model. At the Winnemucca Landfill, which receives a similar amount of average annual precipitation as Millard County, the waste was not observed to be free-draining or even saturated. Accordingly, the use of calculated values from the Winnemucca waste for the initial moisture content of the waste at the Millard County Landfill is a relatively realistic representation of the *in situ* condition of the waste mass. In addition, since the initial moisture content of waste in the HELP simulations was set equal to the default wilting point of waste, and the HELP model considers moisture in excess of wilting point to be available for percolation, any fluid which enters the waste layers is susceptible to percolation. The combination of conservative input parameters for soil and realistic values for waste, in conjunction with numerous additional conservative assumptions for the remaining input parameters, results in a conservative estimate of leachate percolation.

As a means of comparison, an additional HELP simulation was performed using the calculated average initial soil moisture content; all other input parameters remained the same as the runs submitted with the waiver application. The results of the simulation are attached. The results indicate an increase in percolation from the base of the landfill of only 1/100th of an inch. Based on the new simulation, the use of the calculated initial moisture content instead of the default value results in a negligible increase in leachate percolation.

MILLARD COUNTY LANDFILL
RUN 4 - 2 YEARS (SOIL TEXTURE #5 & WASTE #18 W/ADJUSTED M_S)
DECEMBER 16, 1994

BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER
THICKNESS = 12.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1309 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3825 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER
THICKNESS = 48.00 INCHES
POROSITY = 0.5200 VOL/VOL
FIELD CAPACITY = 0.2942 VOL/VOL
WILTING POINT = 0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000199999995 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER
THICKNESS = 12.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1309 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3825 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER
THICKNESS = 48.00 INCHES
POROSITY = 0.5200 VOL/VOL
FIELD CAPACITY = 0.2942 VOL/VOL
WILTING POINT = 0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000199999995 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER
THICKNESS = 12.00 INCHES
POROSITY = 0.4570 VOL/VOL
FIELD CAPACITY = 0.1309 VOL/VOL
WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3825 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER
THICKNESS = 48.00 INCHES
POROSITY = 0.5200 VOL/VOL
FIELD CAPACITY = 0.2942 VOL/VOL
WILTING POINT = 0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000199999995 CM/SEC

LAYER 7

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3825 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 8

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 9

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3825 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 10

VERTICAL PERCOLATION LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	83.31
TOTAL AREA OF COVER	=	36000. SQ FT
EVAPORATIVE ZONE DEPTH	=	16.00 INCHES
POTENTIAL RUNOFF FRACTION	=	0.000000
UPPER LIMIT VEG. STORAGE	=	7.5640 INCHES
INITIAL VEG. STORAGE	=	5.1504 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	56.5740 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR MILFORD UTAH

MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 138
END OF GROWING SEASON (JULIAN DATE) = 276

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.00	32.70	39.70	47.80	57.60	67.50
75.70	73.40	63.30	51.00	37.40	27.70

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.51	0.29	0.85	0.94	0.75	0.17
	0.21	0.50	0.73	0.38	0.66	0.92
STD. DEVIATIONS	0.37	0.25	0.02	0.10	0.86	0.24
	0.28	0.23	0.87	0.22	0.20	0.60
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.779	0.354	0.998	0.985	0.801	0.410
	0.258	0.343	0.951	0.273	0.348	0.577
STD. DEVIATIONS	0.335	0.065	0.227	0.311	0.766	0.286
	0.099	0.127	1.061	0.124	0.270	0.015
PERCOLATION FROM LAYER 10						
TOTALS	0.0006	0.0006	0.0007	0.0008	0.0008	0.0008
	0.0009	0.0009	0.0009	0.0009	0.0009	0.0010
STD. DEVIATIONS	0.0005	0.0003	0.0003	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 2

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	6.94	(0.233)	20805.	100.00
RUNOFF	0.000	(0.000)	0.	0.00
EVAPOTRANSPIRATION	7.076	(0.761)	21228.	102.03
PERCOLATION FROM LAYER 10	0.0099	(0.0026)	30.	0.14
CHANGE IN WATER STORAGE	-0.151	(0.992)	-452.	-2.17

PEAK DAILY VALUES FOR YEARS 1 THROUGH 2

	(INCHES)	(CU. FT.)
PRECIPITATION	0.53	1590.0
RUNOFF	0.000	0.0
PERCOLATION FROM LAYER 10	0.0000	0.1
SNOW WATER	0.72	2157.4

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3219

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0894

FINAL WATER STORAGE AT END OF YEAR 2

LAYER	(INCHES)	(VOL/VOL)
1	1.86	0.1548
2	8.98	0.1870
3	1.74	0.1451
4	9.56	0.1992
5	1.75	0.1456
6	9.57	0.1993
7	1.75	0.1456
8	9.57	0.1993
9	1.75	0.1456
10	9.57	0.1993

SNOW WATER 0.19

State of Utah

DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF SOLID AND HAZARDOUS WASTE

Michael O. Leavitt
Governor
Dianne R. Nielson, Ph.D.
Executive Director
Dennis R. Downs
Director

288 North 1460 West
P.O. Box 144880
Salt Lake City, Utah 84114-4880
(801) 538-6170 Voice
(801) 538-6715 Fax
(801) 536-4414 T.D.D.

February 13, 1995

Robyn R. Pearson
County Administrator
Millard County
PO Box 854
Delta, Utah 84624

Subject: Application for Waiver of Ground Water Monitoring and Liner Requirement at the Millard County Landfill

Dear Mr. Pearson:

The waiver application, received November 10, 1994, and your responses to the Request for Additional information received January 12, 1995, have been reviewed.

The final determination of any waiver can only be made with the issuance of a permit. A permit is issued only after all permit application information has been reviewed, the opportunity for public comment has been presented, and the entire permitting process has been completed.

With the issuance of the permit, the Millard County Landfill may receive a waiver from ground water monitoring and liner requirements. This action will be based on all submitted information, assuming that no conflicting information becomes evident during the permitting process and the plan of operation and the closure plan insure that the development and migration of leachate is minimized.

If you have questions or need further information, please contact Ralph Bohn or Carl Wadsworth at 801-538-6170.

Sincerely,

Dennis R. Downs

Dennis R. Downs, Executive Secretary
Utah Solid and Hazardous Waste Control Board

DRD/CEW/jch

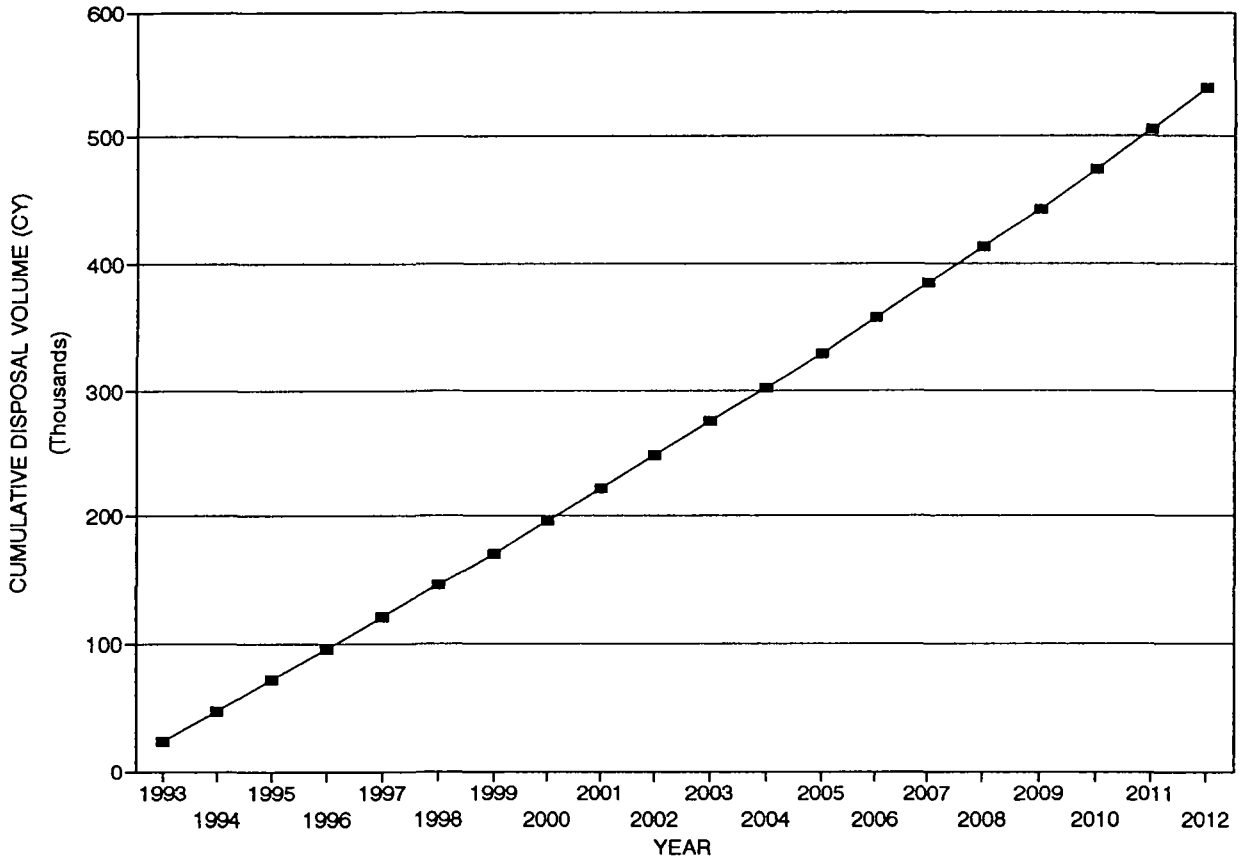
c: Robert Resendes, M.B.A., M.T., Director, Central Utah Public Health Department
Roger Foisy, DEQ District Engineer
Douglas J. Martin, Director of Environmental Affairs, Vector Engineering, Inc.

F:\CWadswor\WP\millard.co\GW-Liner.Let
File: Millard Co. Landfill

APPENDIX F
Loading Rate Calculations

MILLARD COUNTY LANDFILL

Loading Rate Projections



APPENDIX G
Correspondence from Utah Division of Water Rights

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert L. Morgan
State Engineer

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

1636 West North Temple, Suite 220
Salt Lake City, UT 84116-3156
801-538-7240
801-538-7467 (Fax)

FAX COVER SHEET

Date: November 16, 1994 Time: 2:00 PM

TO:

Name: BREESE BURNEY

Agency: VECTOR ENGINEERING INC

Fax Number: (702) 883-7161

FROM:

Name: BARBARA T

Agency: Division of Water Rights/Well Drilling Section

Fax Number: (801) 538-7467

TOTAL PAGES including cover sheet:

COMMENTS:

RE: 2,000 ft radius , Millard County Landfill, North Half of SE quarter of Section 24, Township 17 South, Range 6 West.

We show no existing or abandoned wells in the above referenced area.

If you should have any questions, do not hesitate to contact me at (801) 538-7416

UTAH
NATURAL RESOURCES
1636 West North Temple • Suite 316 • Salt Lake City, UT 84116-3193 • (801) 538-7200 • Fax (801) 538-7315

fax

FACSIMILE COVER SHEET

Date _____

Time _____

To:

Name Breese Burnley

Agency Vector Engineering

Fax no. 702-883-7161

From:

Name John Colbert

Agency Water Rights

Fax no. ~~(801) 538-7315~~ 801-538-7467

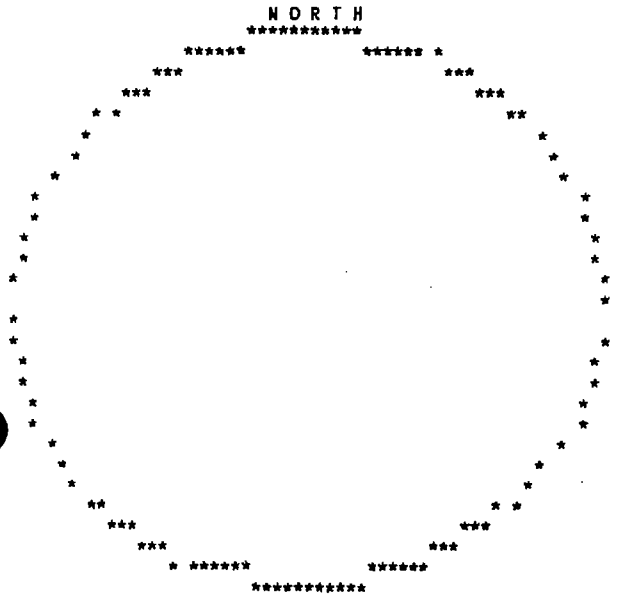
Number pages transmitted including cover sheet 2

Comments _____

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED WED, MAR 1, 1995, 2:36 PM
PLOT SHOWS LOCATION OF 0 POINTS OF DIVERSION

PLOT OF AN AREA WITH A RADIUS OF 3500 FEET FROM A POINT
S 660 FEET, W 1320 FEET OF THE E4 CORNER,
SECTION 24 TOWNSHIP 17S RANGE 6W SL BASE AND MERIDIAN

PLOT SCALE IS APPROXIMATELY 1 INCH = 2000 FEET



APPENDIX H
Drainage Report

DRAINAGE REPORT

Millard County Landfill

(included as Appendix H to the
Application for a Permit to Operate
a Class I Municipal Solid Waste Landfill
at the Millard County Landfill)

1.0 INTRODUCTION

This drainage report has been prepared as supporting documentation to the *Application for a Permit to Operate a Class I Municipal Solid Waste Landfill at the Millard County Landfill*, and is included with the permit application as Appendix H. The purpose of this drainage report is to compare existing and post-closure drainage conditions, and to determine the appropriate post-closure drainage configurations necessary to collect and control the run-off resulting from a 25-year, 24-hour storm event.

The Millard County Landfill is located approximately four miles east-southeast of the City of Delta in Millard County, Utah. The site is an existing landfill which accepts approximately 20 to 25 tons of waste per day, and is therefore considered a Class I facility as defined by the Utah Solid Waste Permitting and Management Rules (UAC R513-301-2). Due to the relatively flat topography of the area, the final closed surface of the landfill was designed as a series of three ridges running east to west across the property, separated by two internal drainage swales and surrounded by an internal perimeter drainage channel. The conceptual closure design is illustrated on Drawing C-1 in Appendix I. The northern and southern sections of the interior perimeter drainage slope to the west at 0.8 to 1.1 percent grades. The eastern and western sections grade at approximately 0.6 percent to the south, while the middle drainage slopes at 0.76 percent to the south. The site was divided by the middle drainage to break up the long drainage distance from east to west across the property, and to allow for an increase in drainage slopes.

2.0 METHOD

Drainage analyses were performed for existing and post-closure surface conditions. In the analysis of existing drainage conditions, the 80-acre site was divided into three separate drainage areas, as illustrated on Plate 1 of this appendix, based on the existing topography. For the post-closure drainage analysis, the site was also divided into three drainage areas, which were further divided into subareas based on the proposed site design. The post-closure drainage subareas are illustrated on Plate 2 of this appendix.

The United States Department of Agriculture Soil Conservation Service (SCS) TR-55 methodology was used to calculate peak flood hydrographs (USDA, 1986) for each of the drainage areas. Rainfall intensity data used in the TR-55 method were derived from the Precipitation Frequency Atlas of the United States - Volume VI - Utah (NOAA, 1973). The 25-year, 24-hour storm depth used was 1.9 inches, while a two-year storm depth of 0.95 inches was used.

Hydrologic soil groups within the drainage areas were identified using the Soil Conservation Service (SCS) *Soil Survey of the Delta Area, Part of Millard County* (USDA, 1977). The 80-acre site contains two soil groups identified in the survey, the Uvada silt loam and the Uvada-Yenrab complex, composed of silt loam and fine sand. Both soils are classified as hydrologic soil group D. Field observations revealed the cover type to be sagebrush with grass understory. The cover type and hydrologic soil group

classification were used to select the appropriate runoff curve number from Table 2-2d of TR-55 (USDA, 1986). As such, the existing site conditions were given a runoff curve number of 85. Since the site closure plan calls for the revegetation of all disturbed areas with native vegetation, the same curve number was used for the drainage analysis for post-closure conditions.

Manning's values for drainage surfaces were derived from Merritt (1983). All unlined earthen drainages were given a Manning's value of 0.022, appropriate for clean, uniform, excavated earth. Culverts 1, 2, and 3 were given a Manning's value of 0.024 for corrugated metal storm drains, based on information presented in Table 21-11 from Merritt (1983).

A node was identified for each drainage area, and was considered as the point where all flow exits a particular area. The node locations remained the same for both the existing and post-closure analyses. For the post-closure analysis, the drainage areas and outflow locations were selected to minimize outflow volumes and velocities, and to minimize the disturbance to the natural drainage pattern of the area.

3.0 RESULTS

The attached output files from the TR-55 computer program (USDA, 1986) illustrate the results of the drainage analyses for both the existing conditions and the proposed post-closure design. Under the existing site conditions, the predicted peak flows from drainage areas A, B, and C are 14, 5, and 11 cubic feet per second (cfs) of run-off, respectively. An analysis of the proposed post-closure design conditions, using the input parameters described above, resulted in predicted peak storm flows for drainage areas A, B, and C of 10, 8, and 10 cfs, respectively. A comparison of the data for existing and post-closure conditions indicates that the predicted outflow at nodes 1 and 3 is reduced for areas A and C, and slightly increased at node 2 for area B, following site development. It is important to note that the total surface area for each drainage area varies between the two sets of analyses (see attached Plates 1 and 2). As a result, the existing and post-closure configurations are considered to exhibit very similar drainage characteristics.

Channels and culverts were sized using the FlowMaster I computer program (Haestad, 1990). The post-closure run-off control system was designed to collect and control the peak flows resulting from a 25-year, 24-hour storm event. Interior and exterior perimeter drainage channels were conservatively sized to be 18 inches deep with 2:1 sideslopes. A channel of this size is capable of containing flows of more than 18 cfs. TR-55 calculations predict a maximum flow of 10 cfs in any particular drainage. All three culverts proposed in the conceptual closure design presented in Drawing C-1, Appendix I, were conservatively sized with a diameter of 24 inches. A 24-inch culvert at a slope of two percent has a flow capacity of more than 17 cfs, much greater than the 10 cfs maximum predicted by TR-55. Supporting calculations for channel and culvert sizing using FlowMaster I are attached with this appendix.

4.0 CONCLUSIONS

Based on the results of the drainage anaylses, the net effect of the development of the site will be minimal and does not warrant the detention of run-off waters from the closed surface of the landfill. The results of the FlowMaster I calculations indicate that the channels and culverts have been appropriately sized to collect and control the run-off resulting from a 25-year, 24-hour storm event.

Although the predicted flow velocities from the FlowMaster I output files are less than four feet per second in the open channels, and less than 6 feet per second in the culverts, rip-rap channel protection should be used at all drainage intersections and culvert inlets and outlets. Since the highest velocities will occur at drainage bends, all drainage intersections and corners should be rip-rap lined at least 20 feet either side of the intersection or corner. Rip-rap protection should be installed completely around each culvert inlet, and from each culvert outlet to at least twenty-feet downstream from the culvert outlet. Median rip-rap diameter should be four inches for all locations. The rip-rap should be well-graded and 50 percent of the mixture by weight should be larger than four inches. The largest stone should be less than six inches in diameter, and the smallest stone should not be less than three inches. The thickness of the rip-rap layer should be at least 12 inches if a filter layer is not used, and at least eight inches if a filter layer is used. Rip rap sizes were determined using charts from ASCE (1992), presented at the end of this section.

5.0 REFERENCES

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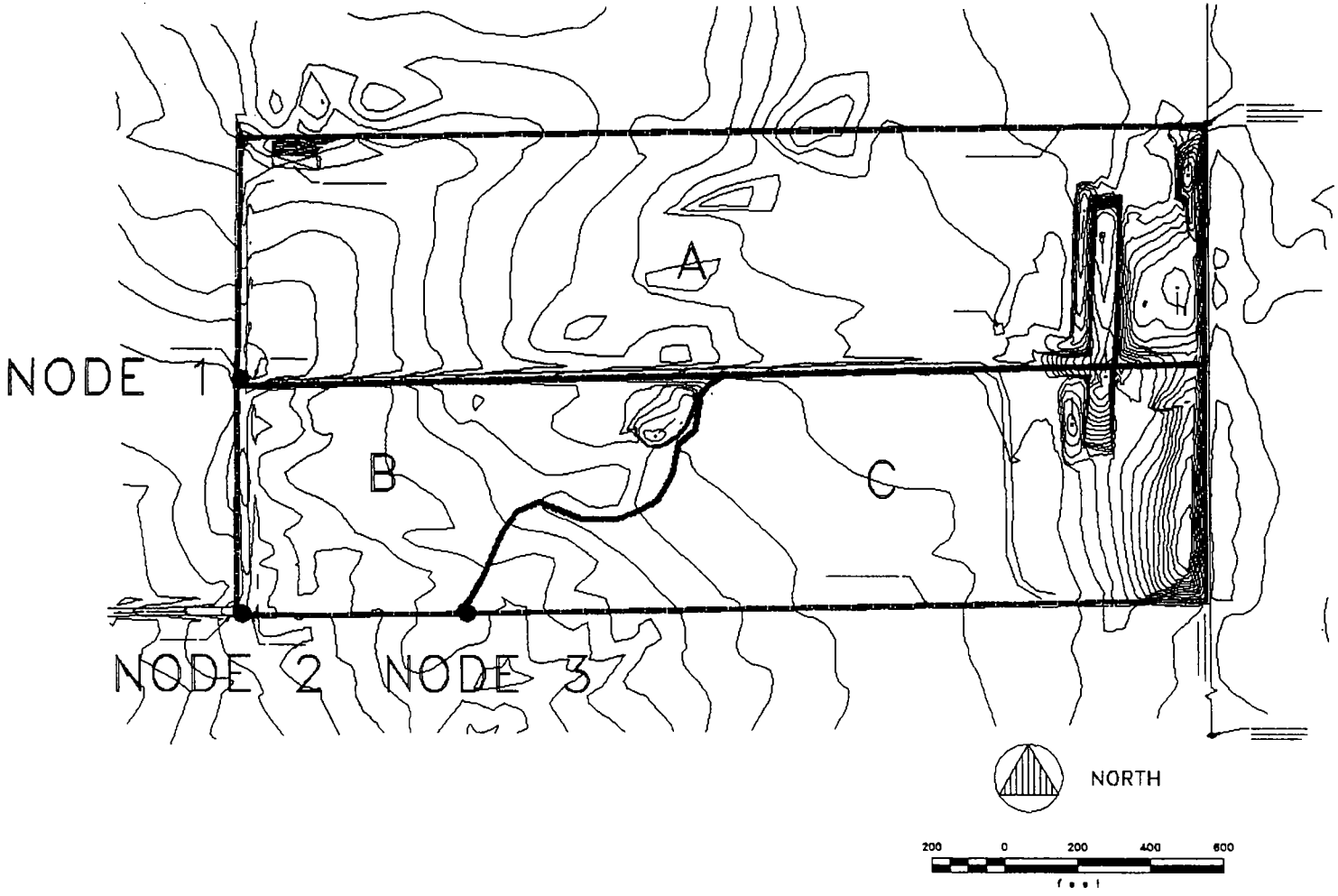
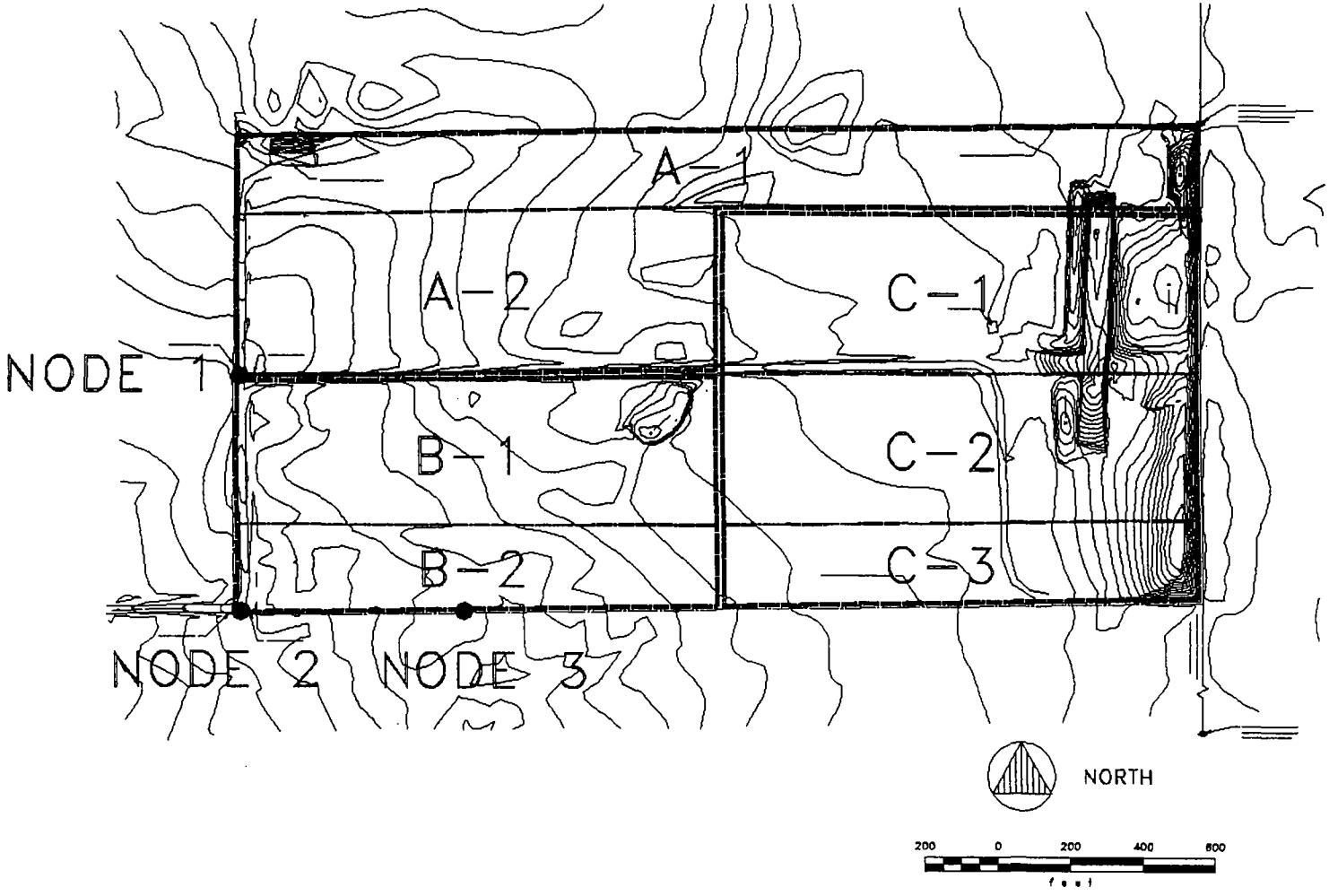


VECTOR ENGINEERING, INC 1601 Fairview Avenue - Suite H, Carson City, NV 89701 JOB NO. 94-5013.01 APPR. DATE 2/21/95	MILLARD COUNTY LANDFILL Hydraulic Subareas: Existing Conditions	PLATE 1



VECTOR ENGINEERING, INC 1601 Fairview Avenue - Suite H, Carson City, NV 89701 JOB NO. 94-5013.01 APPR. DATE: 2/21/95	MILLARD COUNTY LANDFILL Hydraulic Subareas: Developed Site	PLATE 2

TR-55 Results - Existing Site Conditions

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (A)
Subarea : A

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	40.3(85)
Total Area (by Hydrologic Soil Group)				40.3

SUBAREA: A TOTAL DRAINAGE AREA: 40.3 Acres WEIGHTED CURVE NUMBER:85*

* - Generated for use by GRAPHIC method

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (A)

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Tim (hr
Sheet	0.95	300	0.02	E					0.68
Shallow Concent'd		2400	.011	U					0.39
								Time of Concentration =	1.08*
									=====
Shallow Concent'd		2400	.011	U					0.39
								Travel Time =	0.39*
									=====

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by GRAPHIC method

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (A)

Data: Drainage Area : 40.3 * Acres
Runoff Curve Number : 85 *
Time of Concentration: 1.08 * Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1
Frequency (yrs)	25
24-Hr Rainfall (in)	1.9
Ia/P Ratio	0.19
Runoff (in)	0.72
Unit Peak Discharge (cfs/acre/in)	0.491
Pond and Swamp Factor 0.0% Ponds Used	1.00
Peak Discharge (cfs)	14

* - Value(s) provided from TR-55 system routines

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (B)
Subarea : B

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D	Acres (CN)
ARID AND SEMIARID RANGELANDS					
Sagebrush (w/ grass understory) poor	-	-	-		14.7(85)
Total Area (by Hydrologic Soil Group)					14.7

SUBAREA: B TOTAL DRAINAGE AREA: 14.7 Acres WEIGHTED CURVE NUMBER:85*

* - Generated for use by GRAPHIC method

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (B)

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Tim (hr
Sheet	0.95	300	.007	E					1.03
Shallow Concent'd		800	.014	U					0.11
								Time of Concentration =	1.16*
									=====
Shallow Concent'd		800	.014	U					0.11
								Travel Time =	0.12*
									=====

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by GRAPHIC method

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (B)

Data: Drainage Area : 14.7 * Acres
Runoff Curve Number : 85 *
Time of Concentration: 1.16 * Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1
Frequency (yrs)	25
24-Hr Rainfall (in)	1.9
Ia/P Ratio	0.19
Runoff (in)	0.72
Unit Peak Discharge (cfs/acre/in)	0.469
Pond and Swamp Factor 0.0% Ponds Used	1.00
Peak Discharge (cfs)	5

* - Value(s) provided from TR-55 system routines

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (C)
Subarea : C

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	25(85)
Total Area (by Hydrologic Soil Group)				25

SUBAREA: C TOTAL DRAINAGE AREA: 25 Acres WEIGHTED CURVE NUMBER:85*

* - Generated for use by GRAPHIC method

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (C)

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Tim (hr
Sheet	0.95	300	0.04	E					0.51
Shallow Concent'd		1300	.007	U					0.26
								Time of Concentration =	0.79*
Shallow Concent'd		1300	.007	U					0.26
								Travel Time =	0.27*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated Surface Codes ---

P Paved
U Unpaved

* - Generated for use by GRAPHIC method

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: EXISTING CONDITIONS (C)

Data: Drainage Area : 25 * Acres
Runoff Curve Number : 85 *
Time of Concentration: 0.79 * Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1
Frequency (yrs)	25
24-Hr Rainfall (in)	1.9
Ia/P Ratio	0.19
Runoff (in)	0.72
Unit Peak Discharge (cfs/acre/in)	0.593
Pond and Swamp Factor 0.0% Ponds Used	1.00
Peak Discharge (cfs)	11

* - Value(s) provided from TR-55 system routines

TR-55 Results - Post-closure Site Conditions

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (A)
Subarea : A-1

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	12.6(85)
Total Area (by Hydrologic Soil Group)				12.6

SUBAREA: A-1 TOTAL DRAINAGE AREA: 12.6 Acres WEIGHTED CURVE NUMBER:85

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (A)
Subarea : A-2

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	12.4(85)
Total Area (by Hydrologic Soil Group)				12.4

SUBAREA: A-2 TOTAL DRAINAGE AREA: 12.4 Acres WEIGHTED CURVE NUMBER:85

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (A)

Subarea #1 - A-1

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	0.02	E					0.517
Open Channel		2300							0.130
Open Channel		650						4.02	0.045
							Time of Concentration =		0.69*
Open Channel		2300							0.130
Open Channel		650							0.045
							Travel Time =		0.17*

Subarea #2 - A-2

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	0.02	E					0.517
Shallow Concent'd		970	.011	U					0.159
Open Channel		250							0.017
							Time of Concentration =		0.69*
Shallow Concent'd		970	.011	U					0.159
Open Channel		250						4.02	0.017
							Travel Time =		0.18*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by TABULAR method

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (A)

Total watershed area: 0.039 sq mi Rainfall type: II Frequency: 25 years

	Subareas	
	A-1	A-2
Area(sq mi)	0.02*	0.02*
Rainfall(in)	1.9	1.9
Curve number	85*	85*
Runoff(in)	0.72	0.72
Tc (hrs)	0.69*	0.69*
(Used)	0.75	0.75
TimeToOutlet	0.18*	0.00
(Used)	0.10	0.00
Ia/P	0.19	0.19

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A-1	A-2
11.0	0	0	0
11.3	0	0	0
11.6	0	0	0
11.9	0	0	0
12.0	0	0	0
12.1	1	0	1
12.2	2	1	1
12.3	3	1	2
12.4	5	2	3
12.5	9	4	5P
12.6	10P	5P	5
12.7	10	5	5
12.8	10	5	5
13.0	7	4	3
13.2	5	3	2
13.4	4	2	2
13.6	3	2	1
13.8	2	1	1
14.0	2	1	1
14.3	2	1	1
14.6	2	1	1
15.0	2	1	1
15.5	2	1	1
16.0	0	0	0
16.5	0	0	0
17.0	0	0	0
17.5	0	0	0
18.0	0	0	0
19.0	0	0	0
20.0	0	0	0
22.0	0	0	0
26.0	0	0	0

P - Peak Flow * - value(s) provided from TR-55 system routines

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (B)
Subarea : B-1

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	12.4(85)
Total Area (by Hydrologic Soil Group)				12.4

SUBAREA: B-1 TOTAL DRAINAGE AREA: 12.4 Acres WEIGHTED CURVE NUMBER:85

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (B)
Subarea : B-2

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	6.25(85)
Total Area (by Hydrologic Soil Group)				6.25

SUBAREA: B-2 TOTAL DRAINAGE AREA: 6.25 Acres WEIGHTED CURVE NUMBER:85

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (B)

Subarea #1 - B-1

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	0.02	E					0.517
Shallow Concent'd		970	0.01	U					0.167
Open Channel		420							0.029
								Time of Concentration =	0.71*
									=====
Shallow Concent'd		970	0.01	U					0.167
Open Channel		420						4.02	0.029
								Travel Time =	0.20*
									=====

Subarea #2 - B-2

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	.034	E					0.418
Open Channel		990							0.051
								Time of Concentration =	0.47*
									=====
Open Channel		990						5.44	0.051
								Travel Time =	0.05*
									=====

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by TABULAR method

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (B)

Total watershed area: 0.029 sq mi Rainfall type: II Frequency: 25 years

	Subareas B-1	B-2
Area(sq mi)	0.02*	0.01
Rainfall(in)	1.9	1.9
Curve number	85*	85*
Runoff(in)	0.72	0.72
Tc (hrs)	0.71*	0.47*
(Used)	0.75	0.50
TimeToOutlet	0.05*	0.00
(Used)	0.00	0.00
Ia/P	0.19	0.19

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) B-1	B-2
11.0	0	0	0
11.3	0	0	0
11.6	0	0	0
11.9	0	0	0
12.0	0	0	0
12.1	2	1	1
12.2	3	1	2
12.3	5	2	3P
12.4	6	3	3
12.5	8P	5P	3
12.6	8	5	3
12.7	7	5	2
12.8	7	5	2
13.0	4	3	1
13.2	3	2	1
13.4	3	2	1
13.6	1	1	0
13.8	1	1	0
14.0	1	1	0
14.3	1	1	0
14.6	1	1	0
15.0	1	1	0
15.5	1	1	0
16.0	0	0	0
16.5	0	0	0
17.0	0	0	0
17.5	0	0	0
18.0	0	0	0
19.0	0	0	0
20.0	0	0	0
22.0	0	0	0
26.0	0	0	0

P - Peak Flow * - value(s) provided from TR-55 system routines

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (C)
Subarea : C-1

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	12.5(85)
Total Area (by Hydrologic Soil Group)				12.5

SUBAREA: C-1 TOTAL DRAINAGE AREA: 12.5 Acres WEIGHTED CURVE NUMBER:85

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (C)
Subarea : C-2

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	12.5(85)
Total Area (by Hydrologic Soil Group)				12.5

SUBAREA: C-2 TOTAL DRAINAGE AREA: 12.5 Acres WEIGHTED CURVE NUMBER:85

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (C)
Subarea : C-3

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
ARID AND SEMIARID RANGELANDS				
Sagebrush (w/ grass understory) poor	-	-	-	6.3(85)
Total Area (by Hydrologic Soil Group)				6.3

SUBAREA: C-3 TOTAL DRAINAGE AREA: 6.3 Acres WEIGHTED CURVE NUMBER:85

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (C)

Subarea #1 - C-1

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	0.02	E					0.517
Shallow Concent'd		990	0.01	U					0.170
Shallow Concent'd		860	.0076	U					0.170
								Time of Concentration =	0.86*
Shallow Concent'd		990	0.01	U					0.170
Shallow Concent'd		860	.0076	U					0.170
								Travel Time =	0.34*

Subarea #2 - C-2

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	0.02	E					0.517
Shallow Concent'd		990	0.01	U					0.170
Shallow Concent'd		430	.0076	U					0.085
								Time of Concentration =	0.77*
Shallow Concent'd		990	0.01	U					0.170
Shallow Concent'd		430	.0076	U					0.085
								Travel Time =	0.26*

Subarea #3 - C-3

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	0.95	212	.044	E					0.377
Open Channel		990							0.059
								Time of Concentration =	0.44*
Open Channel		990					4.64		0.059
								Travel Time =	0.06*

* - Generated for use by TABULAR method

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: ____ Date: _____
Subtitle: CLOSED SITE (C)

--- Sheet Flow Surface Codes ---

A Smooth Surface	F Grass, Dense	--- Shallow Concentrated ---
B Fallow (No Res.)	G Grass, Burmuda	--- Surface Codes ---
C Cultivated < 20 % Res.	H Woods, Light	P Paved
D Cultivated > 20 % Res.	I Woods, Dense	U Unpaved
E Grass-Range, Short		

* - Generated for use by TABULAR method

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : MILLARD COUNTY LANDFILL User: RBB Date: 02-27-95
County : MILLARD State: UT Checked: _____ Date: _____
Subtitle: CLOSED SITE (C)

Total watershed area: 0.049 sq mi Rainfall type: II Frequency: 25 years

	Subareas		
	C-1	C-2	C-3
Area(sq mi)	0.02	0.02	0.01
Rainfall(in)	1.9	1.9	1.9
Curve number	85*	85*	85*
Runoff(in)	0.72	0.72	0.72
Tc (hrs)	0.86*	0.77*	0.44*
(Used)	0.75	0.75	0.40
TimeToOutlet	0.32*	0.06*	0.00
(Used)	0.40	0.10	0.00
Ia/P	0.19	0.19	0.19

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) C-1	C-2	C-3
11.0	0	0	0	0
11.3	0	0	0	0
11.6	0	0	0	0
11.9	0	0	0	0
12.0	1	0	0	1
12.1	1	0	0	1
12.2	4	0	1	3
12.3	5	0	1	4P
12.4	7	1	2	4
12.5	8	1	4	3
12.6	9	2	5P	2
12.7	10P	3	5	2
12.8	9	3	5	1
13.0	10	5P	4	1
13.2	9	5	3	1
13.4	7	4	2	1
13.6	5	3	2	0
13.8	3	2	1	0
14.0	2	1	1	0
14.3	2	1	1	0
14.6	2	1	1	0
15.0	2	1	1	0
15.5	2	1	1	0
16.0	1	1	0	0
16.5	0	0	0	0
17.0	0	0	0	0
17.5	0	0	0	0
18.0	0	0	0	0
19.0	0	0	0	0
20.0	0	0	0	0
22.0	0	0	0	0
26.0	0	0	0	0

P - Peak Flow * - value(s) provided from TR-55 system routines

FLOWMASTER I - Calculations

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: SUBAREA A

Comment: MILLARD COUNTY LANDFILL - CLOSED SITE

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.022
Channel Slope....	0.0060 ft/ft
Discharge.....	10.00 cfs

Computed Results:

Depth.....	1.20 ft
Velocity.....	3.46 fps
Flow Area.....	2.89 sf
Flow Top Width...	4.81 ft
Wetted Perimeter.	5.38 ft
Critical Depth...	1.09 ft
Critical Slope...	0.0100 ft/ft
Froude Number....	0.79 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: SUBAREA C

Comment: MILLARD COUNTY LANDFILL

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.022
Channel Slope....	0.0076 ft/ft
Discharge.....	10.00 cfs

Computed Results:

Depth.....	0.97 ft
Velocity.....	3.52 fps
Flow Area.....	2.84 sf
Flow Top Width...	5.84 ft
Wetted Perimeter.	6.16 ft
Critical Depth...	0.93 ft
Critical Slope...	0.0098 ft/ft
Froude Number....	0.89 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: PERIMETER MAXIMUM

Comment: MILLARD COUNTY LANDFILL - CLOSED CONDITIONS

Solve For Discharge

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.022
Channel Slope....	0.0090 ft/ft
Depth.....	1.50 ft

Computed Results:

Discharge.....	22.10 cfs
Velocity.....	4.91 fps
Flow Area.....	4.50 sf
Flow Top Width...	6.00 ft
Wetted Perimeter.	6.71 ft
Critical Depth...	1.50 ft
Critical Slope...	0.0090 ft/ft
Froude Number....	1.00 (flow is Critical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: CULVERT #2 - ACTUAL

Comment: MILLARD COUNTY LANDFILL - CLOSED CONDITIONS

Solve For Actual Depth

Given Input Data:

Diameter.....	2.00 ft
Slope.....	0.0200 ft/ft
Manning's n.....	0.024
Discharge.....	8.00 cfs

Computed Results:

Depth.....	0.95 ft
Velocity.....	5.41 fps
Flow Area.....	1.48 sf
Critical Depth....	1.01 ft
Critical Slope....	0.0167 ft/ft
Percent Full.....	47.73 %
Full Capacity.....	17.33 cfs
QMAX @.94D.....	18.64 cfs
Froude Number.....	1.11 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: 24" CULVERT MAXIMUM

Comment: MILLARD COUNTY LANDFILL - CULVERT SIZING

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	2.00	ft
Slope.....	0.0200	ft/ft
Manning's n.....	0.024	
Discharge.....	17.33	cfs

Computed Results:

Full Flow Capacity.....	17.33	cfs
Full Flow Depth.....	2.00	ft
Velocity.....	5.52	fps
Flow Area.....	3.14	sf
Critical Depth....	1.50	ft
Critical Slope....	0.0240	ft/ft
Percent Full.....	100.00	%
Full Capacity.....	17.33	cfs
QMAX @.94D.....	18.64	cfs
Froude Number.....	FULL	

Rip-rap Sizing Charts

(from ASCE, 1992)

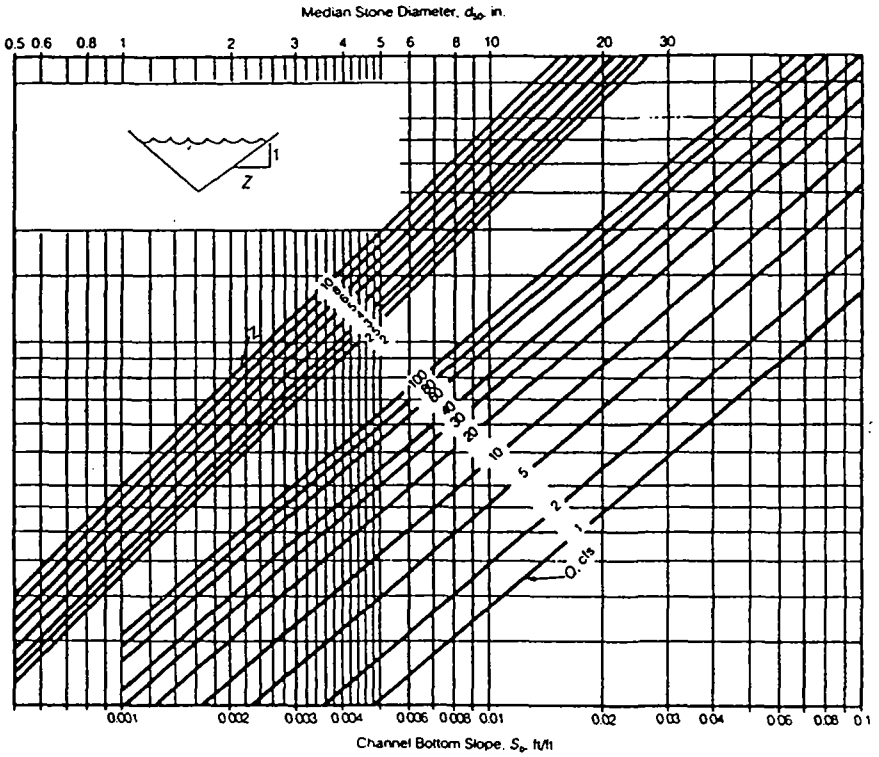


Figure 9.9—Median riprap diameter for straight triangular channels: $d_{50} = 12(64.4\ Q\ S_b^{2.2}\ Z/Z^2 + 1)^{0.4}$ *(in. × 25.4 = mm, cfs × 0.028 32 =* m^3/s*, and ft/ft × 1.0 = m/m) (adapted from Highway Research Board, 1970).*

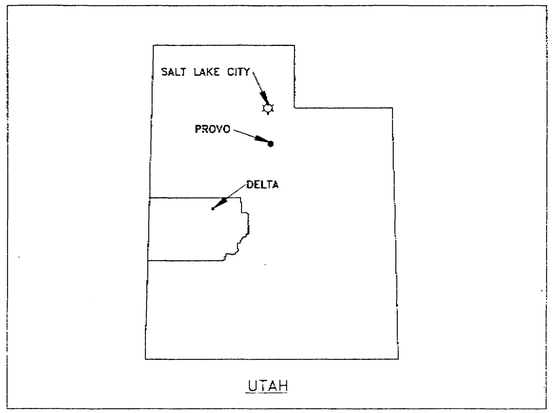
diameter of the largest stone should be 1.5 times the d_{50}. The minimum size of stone is that which is just stable under the design flow condition. The U.S. Department of Transportation (1967) provides riprap gradation that can be used as a guide for selection of the minimum size stone.

4. Thickness of Riprap Lining—Various parameters such as discharge, size of channel, size and gradation of riprap and construction techniques should be considered when estimating the thickness of riprap lining. The following minimum criteria should be met:
   (a) A thickness of at least three times the d_{50} if a filter layer is not used. (A filter is recommended in nearly all cases, however.)
   (b) A thickness of at least two times the d_{50} if a filter layer is used.

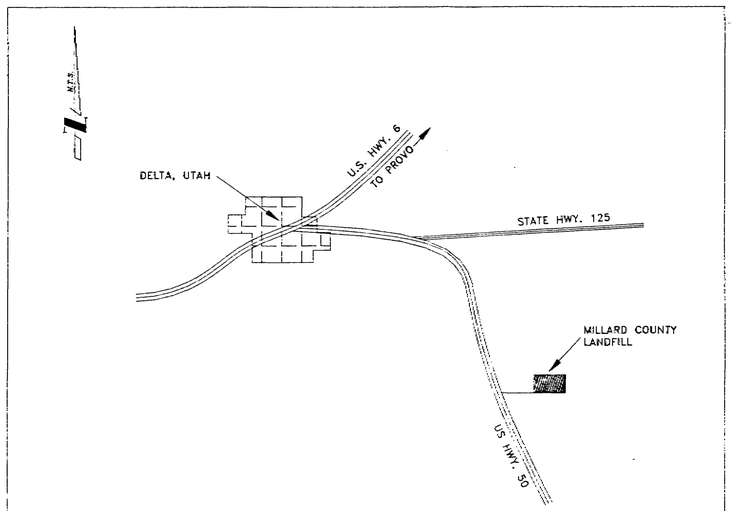
PERMIT APPLICATION

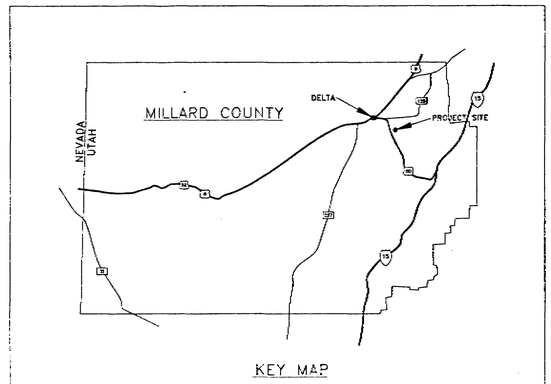
MILLARD COUNTY LANDFILL

MILLARD COUNTY, UTAH



UTAH





KEY MAP

DRAWING NO.	TITLE	REVISION
A-1	TITLE SHEET AND LOCATION MAP	0
B-1	USGS HARDING 7.5' QUADRANGLE	0
B-2	SITE DEVELOPMENT, FACILITIES AND EXISTING TOPOGRAPHY	0
C-1	CONCEPTUAL CLOSURE DESIGN	0
C-2	CROSS SECTIONS	0
C-3	CROSS SECTIONS	0
D-1	DETAILS	0

Designed by:				Drawn by:				Checked by:				App'd				App'd	Rev. No.	Revision	Date	Company

Designed by:	MILLARD COUNTY LANDFILL - PERMIT APPLICATION	Date 2/5/95
RBB		Date
Drawn by:		Date
		Date
Checked by:		Date
DP		Date
App'd		Date
App'd	Rev. No. Revision	Date Vector

Ron Abbott 3/23/95

VECTOR ENGINEERING, INC.

Grass Valley, CA • El Dorado Hills, CA • Carson City, NV • Denver, CO

1601 Fairview Ave. Suite H, Carson City, NV 89701 (702) 883-7065

MILLARD COUNTY LANDFILL

MILLARD COUNTY, UTAH

TITLE SHEET AND LOCATION MAP

MILLARD COUNTY, UTAH

A-1	941201-F	File No: 945013.01	0 Revision

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HARDING QUADRANGLE
UTAH-MILLARD CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

ZONE RF

MILLARD COUNTY
LANDFILL

PROPERTY BOUNDARY

ACCESS ROAD

ZONE RF

ZONE RF

PREVAILING WIND DIRECTION

Harding

Sixmile

Wash

Clay

Spring

Gravel Pit

Sixmile Point

Storage Bins

DELTA NW BASE

PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY
CONTROL BY ..... USGS, NOS/NOAA
COMPILED FROM AERIAL PHOTOGRAPHS TAKEN 1979
FIELD CHECKED ..... 1980 MAP EDITED 1985
PROJECTION ..... LAMBERT CONFORMAL CONIC
GRID: 1000-METER UNIVERSAL TRANSVERSE MERCATOR ..... ZONE 12
10,000-FOOT STATE GRID TICKS ..... UTAH, CENTRAL ZONE
UTM GRID DECLINATION ..... 0°55' WEST
1985 MAGNETIC NORTH DECLINATION ..... 14°30' EAST
VERTICAL DATUM ..... NATIONAL GEODETIC VERTICAL DATUM OF 1929
HORIZONTAL DATUM ..... 1927 NORTH AMERICAN DATUM

To place on the predicted North American Datum of 1983, move the projection lines as shown by dashed corner ticks (8 meters north and 67 meters east)

There may be private inholdings within the boundaries of any Federal and State Reservations shown on this map

All marginal data and lettering generated and positioned by automated type placement procedures

NORTH

PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of field check. 2

SCALE 1:24 000

1 5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000
FEET
1 5 0 1 2
1000 0 METERS 1000 2000

CONTOUR INTERVAL 10 FEET
SUPPLEMENTAL CONTOUR INTERVAL 5 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225
OR RESTON, VIRGINIA 22092

UTAH
QUADRANGLE LOCATION

1	2	3	1 Delta NE 2 Strong 3 Oak City North 4 Delta 5 Oak City South 6 Pavant Butte North 7 Mc Cornick 8 Duggins Creek
4		5	
6	7	8	

ADJOINING 7.5' QUADRANGLE NAMES

INTERIOR-GEOLOGICAL SURVEY, RESTON, VIRGINIA-1985

ROAD LEGEND

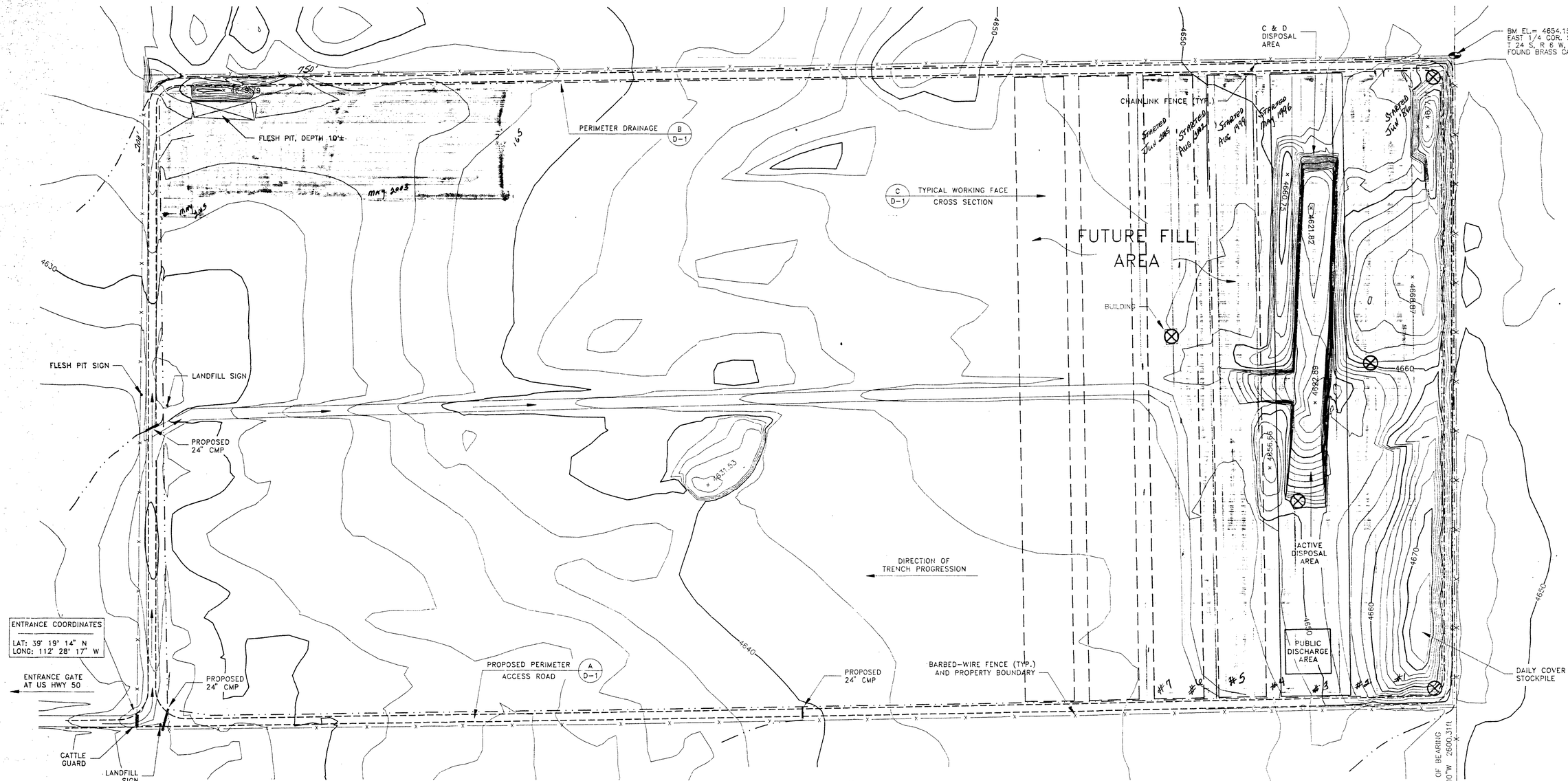
Improved Road .....
Unimproved Road .....
Trail .....

Interstate Route U.S. Route State Route

HARDING, UTAH
PROVISIONAL EDITION 1985

39112-C4-TF-024

DRAWING B-1



NOTES:

1. THE TRENCH CONFIGURATION ILLUSTRATED ON THIS DRAWING IS SHOWN AS-BUILT AS A PART OF THE CURRENT OPERATIONS CONDUCTED BY MILLARD COUNTY. A SLOPE STABILITY ANALYSIS WAS NOT PERFORMED AS PART OF THE SITE DESIGN PRESENTED IN THE DRAWINGS.
2. BORROW SOURCE MATERIAL WILL BE STOCKPILED NATIVE SOIL DERIVED FROM DISPOSAL TRENCH EXCAVATION. AS SUCH, BORROW AREAS INCLUDE ALL AREAS OF FUTURE FILLING.
3. FUTURE GAS MONITORING LOCATIONS WILL BE ADDED AS FACILITY EXPANDS.
4. BASE MAP AND GROUND SURVEY BY SUNRISE ENGINEERING, INC., SALT LAKE CITY, UTAH.

EXPLANATION:

- FUTURE FILL AREA
- EXISTING TOPOGRAPHY
- DRAINAGE CHANNEL
- GAS MONITORING LOCATIONS
- ACCESS ROAD
- LANDFILL TRAFFIC
- DETAIL (DETAIL # / SHEET #)
- FOUR-STRAND BARBED-WIRE FENCE
- CHAINLINK FENCE

NORTH

100 0 100 200 300
feet

Contour Interval: 2 feet

MILLARD COUNTY LANDFILL

EXISTING TOPOGRAPHY/EXISTING AND PROPOSED FACILITIES

MILLARD COUNTY, UTAH

B-2	941201-A	945013.01	0 Revision

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Checked by:					
App'd					
App'd	Rev. No.	Revision	Date	Company	

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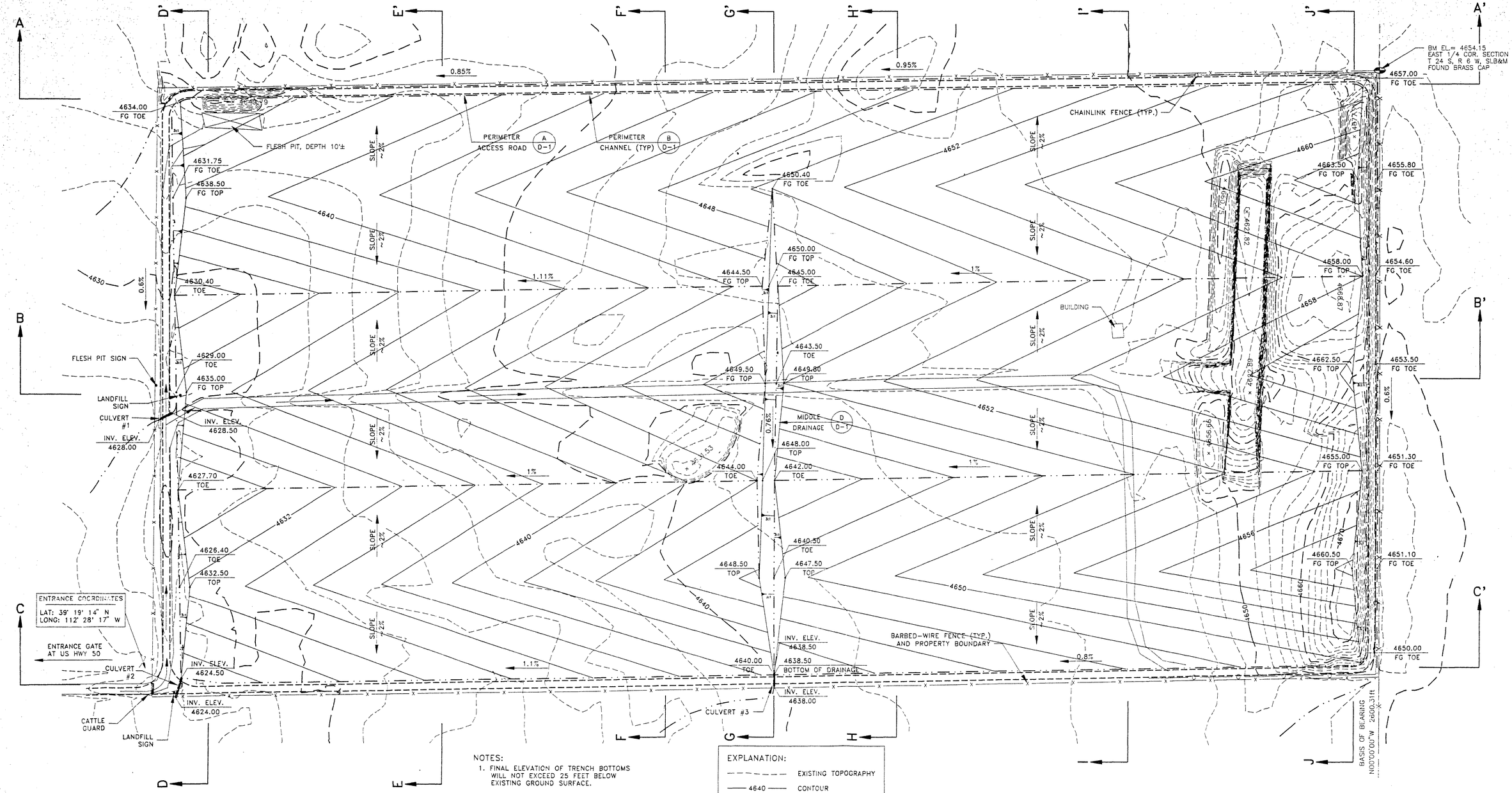
RBB			Date	
Drawn by:			Date	
Checked by:			Date	
DP			Date	
App'd			Date	
App'd	Rev. No.	Revision	Date	Vector

3/23/95

VECTOR ENGINEERING, INC.

Grass Valley, CA • El Dorado Hills, CA • Carson City, NV • Denver, CO

1601 Fairview Ave. Suite H, Carson City, NV 89701 (702) 883-7065



NOTES:

1. FINAL ELEVATION OF TRENCH BOTTOMS WILL NOT EXCEED 25 FEET BELOW EXISTING GROUND SURFACE.
2. FINAL SITE CAPACITY IS BASED ON A 4:1 WASTE TO SOIL RATIO, 20 FEET OF NATIVE SOIL BETWEEN TRENCHES, AND A TRENCH SIZE OF 1000'L X 60'W X 25'D.
3. BASE MAP AND GROUND SURVEY BY SUNRISE ENGINEERING, INC., SALT LAKE CITY, UTAH.

REMAINING CAPACITY
WASTE: 977,800 CY
OVERSOIL: 244,400 CY

EXPLANATION:

- EXISTING TOPOGRAPHY
- 4640 — CONTOUR
- DRAINAGE CHANNEL
- ACCESS ROAD
- LANDFILL TRAFFIC
- DETAIL # / SHEET # — DETAIL
- FOUR-STRAND BARBED-WIRE FENCE
- CHAINLINK FENCE
- FG — FINAL GRADE
- A' — CROSS SECTION LOCATION

NORTH

100 0 100 200 300
feet

Contour Interval: 2 feet

MILLARD COUNTY LANDFILL

CONCEPTUAL CLOSURE DESIGN

MILLARD COUNTY, UTAH

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App'd	Rev. No.	Revision	Date	Vector	

3/2/95

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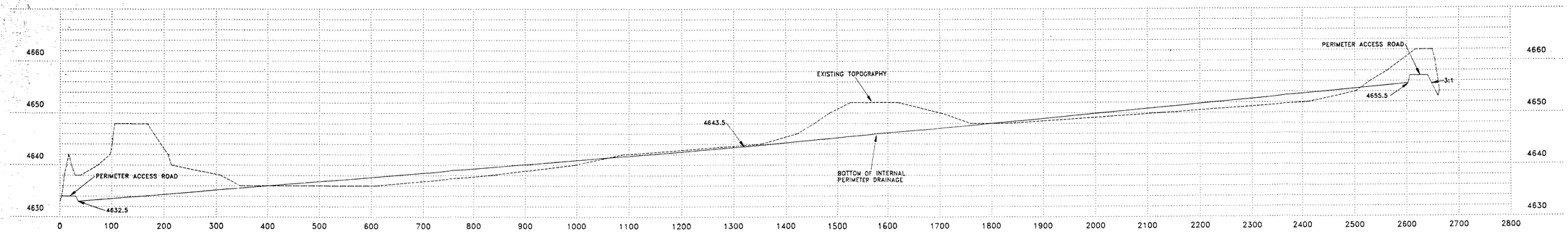
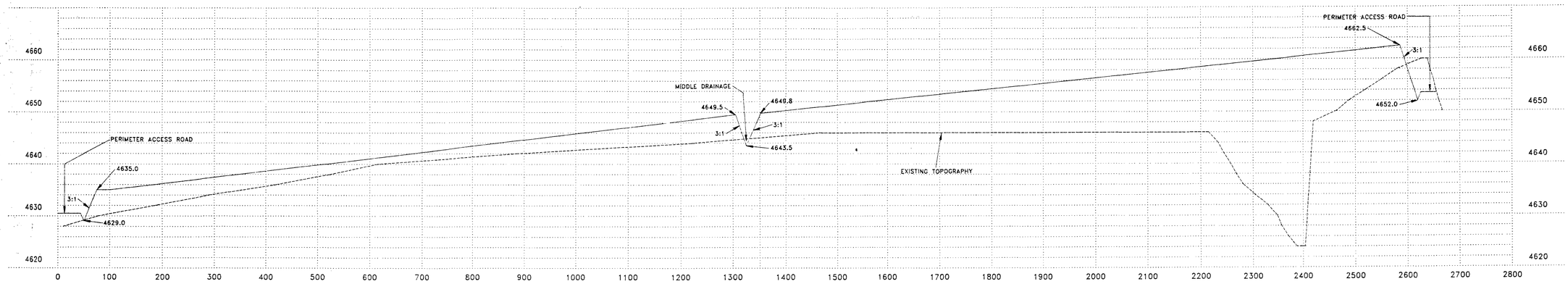
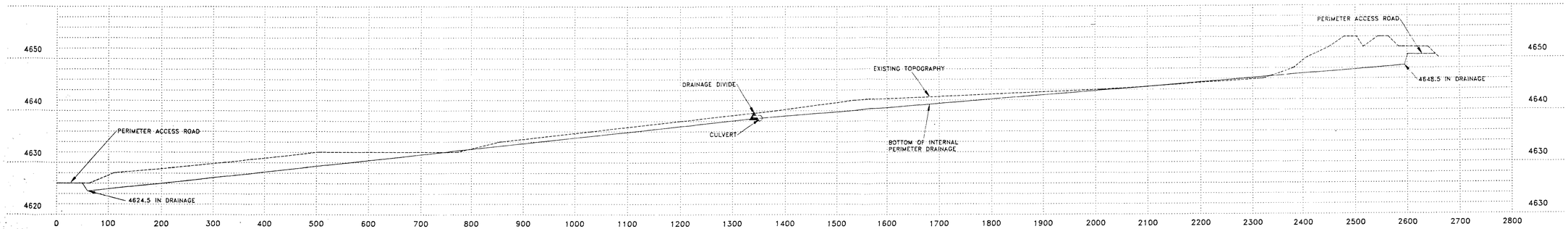
C-1	941201-G	945013.01	0 Revision



PERIMETER DRAINAGE
Section A–A



CENTER RIDGE
Section B–B



PERIMETER DRAINAGE
Section C–C

1" = 100' HORIZONTAL
1" = 10' VERTICAL

Designed by:					
Drawn by:					
Checked by:					
App'd					
App'd	Rev. No.	Revision	Date	Company	

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			Date		
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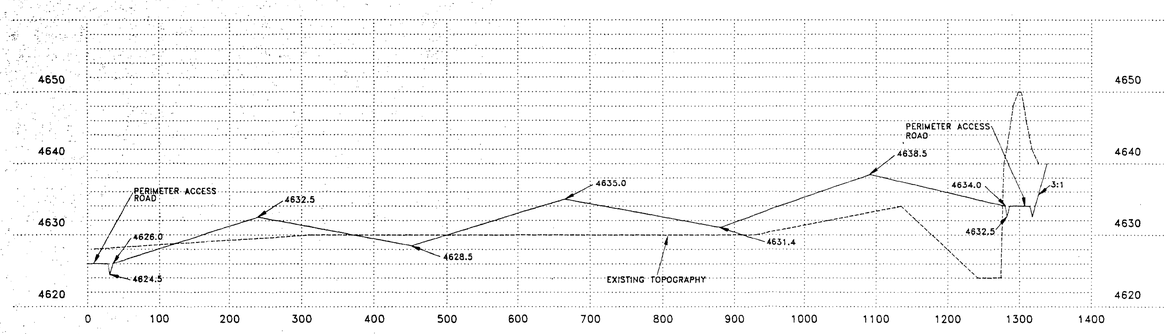
MILLARD COUNTY LANDFILL

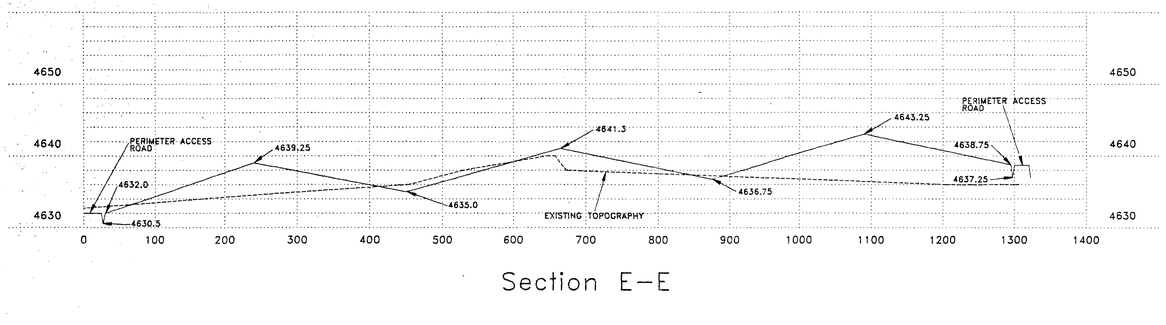
CROSS SECTIONS

MILLARD COUNTY, UTAH

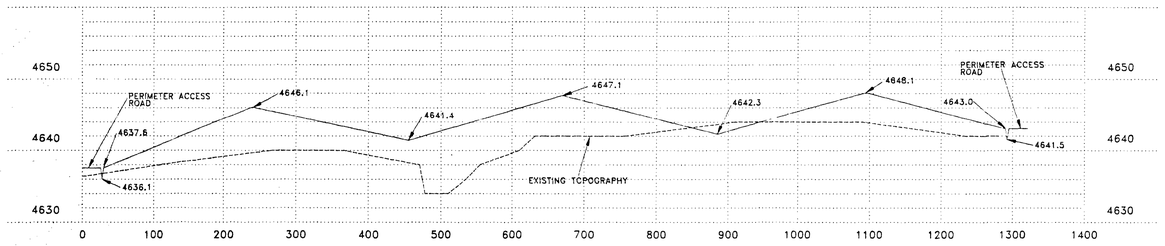
C-2	941201-C	945013.01	0 Revision



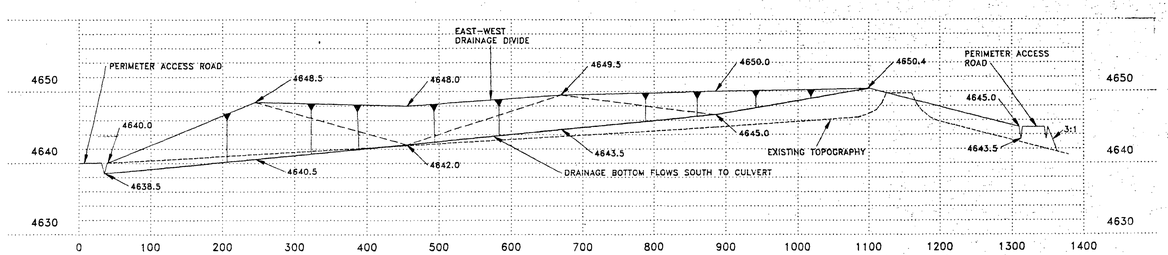
Section D–D



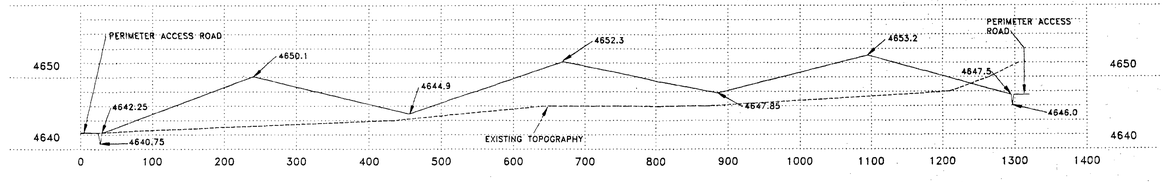
Section E–E



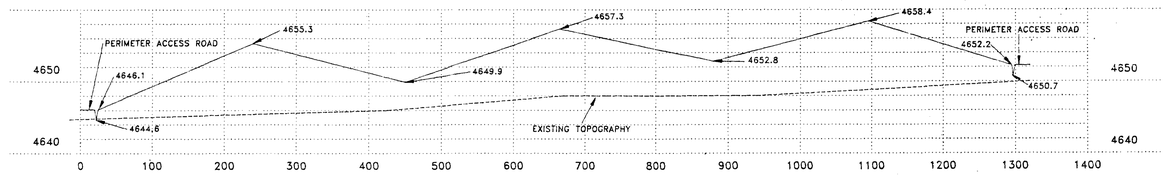
Section F–F



Section G–G



Section H–H



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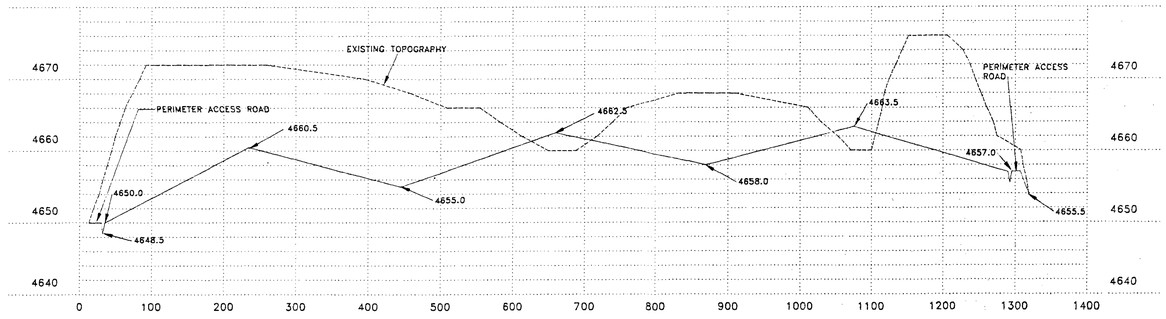

Section J–J

1" = 100' HORIZONTAL

1" = 10' VERTICAL

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Checked by:					
App'd					
App'd	Rev. No.	Revision	Date	Company	

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RBB			Date		
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			Date		
Checked by:			Date		
DP			Date		
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3/24/15

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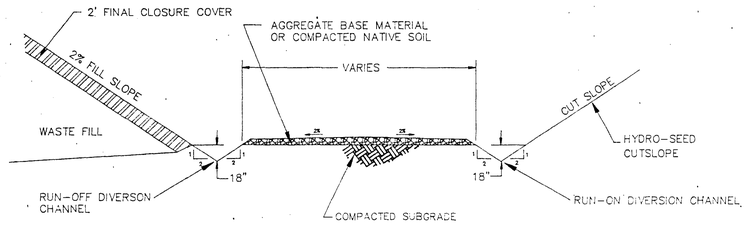
MILLARD COUNTY LANDFILL

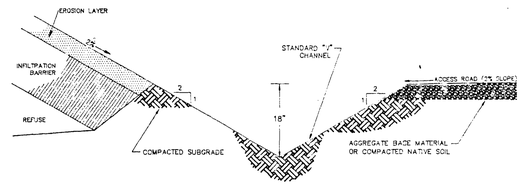
CROSS SECTIONS

MILLARD COUNTY, UTAH

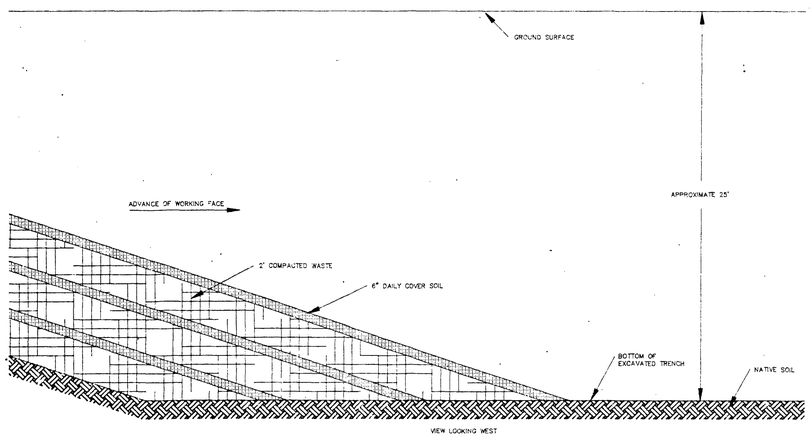
C-3	941201-D	945013.01	0 Revision



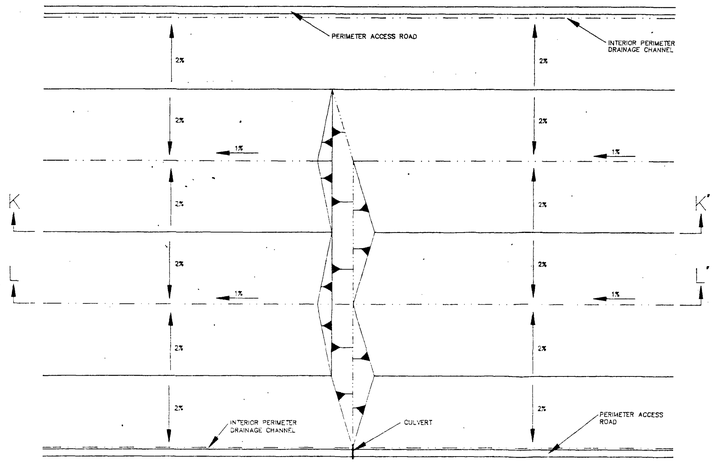
PERIMETER ACCESS ROAD (TYP) — N.T.S. — A



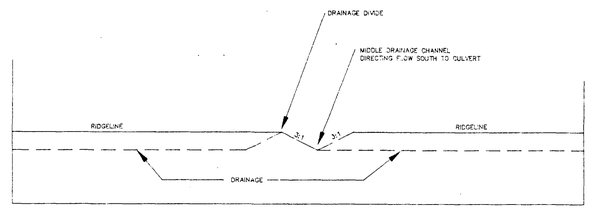
PERIMETER CHANNEL DETAIL (TYP) — N.T.S. — B



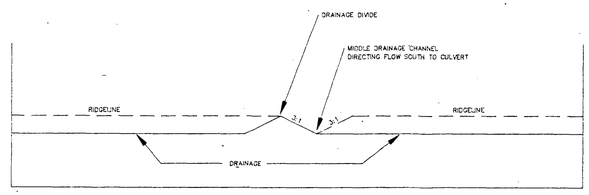
TYPICAL WORKING FACE CROSS SECTION — N.T.S. — C



MIDDLE DRAINAGE DETAIL (SCHEMATIC) — D



SCHEMATIC CROSS SECTION
K – K'



SCHEMATIC CROSS SECTION
L – L'

CROSS SECTIONS

Designed by:					
Drawn by:					
Checked by:					
App'd					
App'd	Rev. No.	Revision	Date	Company	

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Designed by:	RBB		MILLARD COUNTY LANDFILL – PERMIT APPLICATION	Date	2/5/95	
Drawn by:				Date		
Checked by:	DP			Date		
App'd				Date		
App'd	Rev. No.		Revision	Date		Vector

REGISTERED PROFESSIONAL ENGINEER — FULLER — 6206 — 2/28/95 — STATE OF UTAH

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MILLARD COUNTY LANDFILL

DETAILS

MILLARD COUNTY, UTAH

D-1	941201-1	945013.01	0 Revision